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THE ICE BUSINESS FOR CENTRAL STATIONS.

This issue contains a goodly number of reports from central stations, mostly small, which have found it desirable to take up the artificial-ice business. At the present time and with the efficient and easily-cared-for ice machinery which is now available it is pretty certain that artificial ice can compete with the natural product on very favorable terms in almost any part of the United States. The natural-ice business is apparently a somewhat uncertain one. At the beginning of every summer natural-ice companies moan their plaints in the papers. Either the winter has been exceptionally severe, so that the ice is too thick to handle economically, or it has not been severe enough, so that good ice has formed for only a brief period and in small amounts, or there has been too much snow, so that ice is porous and will melt quickly. Every year something happens to make plausible the annual boost in price, and while the cause of the complaints is thus made obvious, they are more or less the result of real conditions.

Every winter is not a good ice winter, and ice is expensive both to store and to transport. Every summer is a good ice-making one for the artificial plant, and its storage charges are nominal. Moreover, the artificial ice, while perhaps no better than, and perhaps not as good as, the best natural ice, runs much more uniformly and is on the whole of considerably better grade. Moreover, the water can be distilled or sterilized before freezing so as to remove the dangers which have been found to exist in the natural product. All these things put the artificial-ice industry in a good strategic position, irrespective of the comparative cost. There is good reason to believe, besides, that the average cost of artificial ice, where reasonably cheap energy is available, is, if anything, rather less than the cost of the natural ice plus storage and distribution charges with the ordinary amount of transportation. The actual cost of artificial-ice making varies, of course, much with the cost of energy and general conditions. Under favorable circumstances it may get down to the neighborhood of $1 a ton in the cans, or it may run to nearly twice this amount.

Electric-light stations, as the reports herewith published show, are in a particularly good position to undertake an economical refrigerating business. In the first place, during the months when ice is chiefly required they always have large spare capacity, both steam and electric, and if motor-driven ice machines are used a beautifully steady load is available for filling up the equipment to its point of maximum efficiency. There are two lines in which activities of central stations can be properly exercised. First, cold storage, on at least a small scale, bringing the convenience of cheap cold storage into the smaller cities and towns. Second, the central station can actually take up the artificial-ice business as such, including its general sale and distribution. Which of these directions it is profitable to take and whether both should be undertaken are things to be determined wholly by local conditions, but, as a rule, in any

given locality, and particularly in the smaller places, the electric-light plant is in a better position to get economical energy than any other industrial plant in the locality.

There are no large manufacturing profits to which the cost of energy is entirely subsidiary, and hence central stations can supply themselves with energy for these special activities at an exceptionally reasonable figure. Moreover, on account of the nature of the demand for energy in electrical distribution it is a positive advantage to the station to have a steady load which can be kept off the peak, for the most part, to bring the generating equipment to its maximum efficiency and so further reduce the cost of supply. Most central stations are looking for something to fill up the valleys in the load curve, and we know nothing better adapted to this service than the production of artificial ice. In how far it would pay large central stations to undertake ice making in which they would have to compete with other operators on a large scale is a matter of some doubt, but in places of relatively small size, and particularly those in the warmer parts of our country, the chances for success are of the best, as the reports we publish in this issue clearly show. In fact, there are not a few cases in which the ice plant provides a reasonable profit which the electric service by itself has scarcely been able to show. In the warmer sections and in small places the transportation, storage and distribution charges against natural ice are at a maximum, so that competition from this source can be very easily met. Ice manufactured on the spot and at about the rate needed and distributed immediately has an immense economic advantage.

The practical question at which many central-station managers would hesitate is the desirability of going into, as a business proposition, a line of activity far removed from the one to which they are accustomed. This difficulty is real and must be considered most seriously in large centers of population. In the smaller places the new line of operations is much less difficult. The central-station forces know the people of the community exceedingly well and can pretty accurately judge the size and character of the market for artificial ice. The bookkeeping and collecting departments are used to handling small items and are generally not so busy throughout the summer months as to require any large increase of force in undertaking the sale of ice. The distribution of the product is the main new line of operations to be undertaken, and the managers of small central stations are generally no novices in the problems of transportation which make up this particular task. Altogether it is certain that the ice business in nearly every case where it has been undertaken by central stations has proved a success, often a conspicuous success. It certainly deserves to be tried in a very large number of cases on account of the particularly desirable character of the load in its effect on the ordinary business of a central station.

TEACHING THE YOUNG TO RESPECT ELECTRICITY.

With the rapid extension of wires carrying electricity in all sections of the country boys and girls—more particularly the boys, of course—should be taught to have a wholesome respect for any electric circuit. There is an old-fashioned saying that fire is a good servant but a bad master. The truth sought to be conveyed by this proverb is equally applicable to electricity, and the fact is one that should be impressed on the young. The rising generation should be familiarized with electricity as an agent that is doing useful work in many departments of human endeavor, but at the same time as something that is not to be trifled with. This does not mean, of course, that the child is not to be permitted to amuse himself, and perhaps to acquire some rudiments of practical knowledge, by playing with electric toys operated by a cell or two of dry battery. But it does mean that the active boy shall be brought to have some such precautionary knowledge of electricity as he has of gravitation. He knows that he can jump off a step 2 ft. high with impunity, but that if he falls from the limb of a tree 30 ft. high he will probably be hurt and possibly killed. Inasmuch as it is impossible to tell by looking at electrical conductors whether they are carrying dangerous or innocuous currents, the boy should be taught, at home and in school, to let all electric wires severely alone for his own protection. If this fact were fixed firmly in the boy's mind, a youngster would be no more inclined to throw a loose wire over a high-potential circuit "on a dare" than he would to jump off a high building. Here and there a young life could be saved if the truth of this comparison were deeply impressed on the youthful intelligence.

STEALING ELECTRICITY.

Central-station managers in many of the large cities have been annoyed by occasional instances of the theft of electricity, often accomplished by placing a jumper around the watt-hour meter on the customer's premises so that energy could be secured without actuating the meter. Of course the amount of electricity secured by fraudulent means is small in any city compared with the total output. Nevertheless the practice is one to which the sellers of electricity are and must be resolutely opposed. Owing to the intangible nature of this product the older laws against larceny were inadequate to prevent theft of this nature, and in many of the states statutes have been passed with the explicit intention of preventing the stealing of electricity. One of the more recently enacted of these statutes is in the State of Missouri, where the law has been in force about two years.

Generally stated, the purpose of the Missouri law is declared to be "to prevent and punish unlawful conversion and wrongful use of electric current, commonly known as electricity." However, the law is designed also to check unlawful interference with electrical appliances, and penalties are provided both for the fraudulent user of electricity and the person who uses a knowledge of electrical apparatus to enable wrong to be committed. The law is divided into three sections. The first relates to those who use devices to "beat" meters, the second reaches those who tamper with electrical equipment, and the third applies to those who accept or receive electrical energy unlawfully diverted by some device intended to defraud. The offense is declared to be a misdemeanor in any case and is punishable by a fine of from $50 to $500 or by imprisonment from three to twelve months, or by both fine and imprisonment.

Of especial interest is the manner in which this law has been applied, particularly in St. Louis, where the electric-service company has been active in fighting the electricity thieves. The first conviction was secured about a year ago, and since then one prison sentence and half a dozen fines have been imposed. At first the St. Louis courts were disposed to be lenient, but the

penalties are now becoming more severe. The prison sentence was passed in the case of an ex-counterfeiter, who displayed considerable skill in lighting his flat without paying for it. He made connection with a feed wire outside the building, using a water pipe in the kitchen for a ground connection. This man was sent to the workhouse for six months. The other offenders, saloon keepers, restaurant keepers, small tradesmen, etc., were fined from $50 to $100. The central-station company's inspectors and "secret-service" men have proved vigilant, and the St. Louis company is entitled to hearty commendation for its efforts, which have a widespread moral value.

SUBTRACTIVE PRODUCTION OF DAYLIGHT.

We are so much accustomed to take daylight on faith as a natural and invariable standard of color, and so little accustomed to measuring the color of daylight at different times and seasons, that the information of its variation comes at first as a shock to the sense of standards and a disillusion to the sense of moral rectitude in the established order of things. When, however, we learn that there is a very material difference between the color of daylight on a bright day at noon and at bright sunrise, likewise a still greater difference between the color of daylight on a bright noonday and at a cloudy sunrise, we take some philosophic comfort from the reflection that only Zoroastrians maintain the perpetual perfection and invariation of the sun. Moreover, on second thoughts it is self-evident that the color of daylight is a function of altitude, terrestrial latitude, season of the year, state of the weather and the atmospheric momentary contents of moisture and dust. The apparent colors of flowers, tapestries and dyes are manifestly different in hue as well as in intensity under different combinations of conditions. The change of hue in a rose under cloud and under sunshine is evidently not a mere matter of intensity. The difference lies not in the petals but in the color of the incident light.

The change in the color of daylight must be due either to change in the colors emitted by the sun or to change in the colors absorbed by the atmosphere. Concerning changes in the colors emitted by the sun we know little. In and near a sunspot the color of the emitted light evidently varies much, but taking the sun as a whole the color of the emitted light seems not to vary appreciably. For practical purposes at least all of the change in daylight color occurs in the passage of the sun's rays through the earth's atmosphere. If the air absorbed energy equally from all parts of the spectrum occupied by the sun's radiation, then whatever the depth of air through which the radiation had to pass the relative proportions of spectrum energies would remain constant; that is, the color of the residual light would be constant. But the absorption is greater for the shorter waves of light or for the blue end of the spectrum. Hence when the sun's light has to reach us through a long oblique course in the atmosphere, at sunrise or sunset, the blue and green rays have been absorbed in transmission more than the red and yellow, so that the sunrise and sunset light is reddish by comparison with the color of daylight from the zenith sun. The latter comes down to us in the shortest possible path through the air with a maximum of blue and violet.

Accepting "daylight" with all due reserve and grains of salt as a standard white light, we speedily recognize that a gas flame gives a relatively very yellow light, a carbon incandescent lamp a light not quite so yellow, and so on for all the various artificial illuminants. Although some arc lamps emit a considerable proportion of light in the blue, yet, in general, gas and electric lamps do not emit a white light like daylight. They are too lavish at the red and yellow parts of the spectrum. With the exception of the carbon-dioxide tube lamp and the so-called intensified arc lamp artificial illuminants make no pretense to imitating daylight white. Moreover, particular luminous sources, such as the mercury-vapor lamp, give special colors of light that are saliently different from daylight. The tungsten, Nernst and carbon-arc lamps give light coming nearest to daylight white, but which at best differs therefrom very evidently. The first result of a color difference between artificial light and daylight is a sense of imperfection in the artificial light, which is a subjective impression and can to a greater or less extent be overcome by habit. The second result is that color-matching by night cannot be made to agree with color-matching by day. The average individual is neither often called upon to make color matches by night nor particularly desirous of making the attempt, but nearly all painters and workers in color compositions are perforce reduced to quitting their vocations after dusk. Consequently, an artificial reproduction of daylight has practical as well as merely esthetic value.

Excepting the lamps mentioned above daylight-imitating luminous sources are usually synthetic devices. That is to say, they give associations of colored lights so assorted as mutually to compensate for one another's color deficiencies and so to build up a resultant white. In the article by Messrs. H. E. Ives and M. Luckiesh appearing in this number the opposite expedient is adopted of taking a single luminous source, by preference the tungsten lamp, and absorbing from its light as nearly as is practicable the relative excesses of superabundant color intensities so as to reduce the residual light to nearly a daylight white. This means cutting off the red and yellow beams with a lavish use of the absorbent and thus greatly diminishing the specific luminous output of the source expressed in lumens per watt. It is evident from the nature of the process described in the article that the method is not advocated as a household economy. Daylight lamps would, on this basis, be at least as much worse in efficiency than carbon-filament incandescents as tungsten lamps are better. The change, if adopted wholesale, would be a step backward in national nocturnal economics. But the method is very simple and ingenious. It is so simple that for special color work at night the advantage of being able to accomplish the work that would otherwise have to await the coming dawn may be so great as far to outweigh the relative inefficiency of the process. All that is needed is a box for the tungsten lamps and a specially prepared colored-glass window. Similar considerations apply to the use of incandescent lamps in a photographic developing room. Strictly speaking, only a faint light of red color may be used in developing ordinary photographic pictures. On the basis of economy and luminous efficiency only a single candle should be used behind a ruby-glass window. In practice, however, convenience often dictates the use of a fairly powerful incandescent lamp placed in a box with several red and yellow glass sliding covers. It is to be hoped that if the device described is found to be satisfactory the manufacture of these incandescent artificial daylight sources may be taken up commercially for the benefit of those who have to work in color compositions by night.

The International Electrical Congress at Turin in September.

We learn that the American Institute of Electrical Engineers has appointed a committee representing not only that body, but also indirectly the Bureau of Standards, the United States Committee of the International Electrotechnical Commission, the National Electric Light Association, the Association of Edison Illuminating Companies, the American Electrochemical Society and the American Street Railway Association, to aid the Italian executive committee in the work of preparing for the coming International Electrical Congress at Turin, so far as relates to American representation. As has already been announced in these columns, this congress is scheduled to be held at Turin from Sept. 9 to 20, 1911, during the period of the Italian International Exhibition of Industry and Labor. Americans connected with any of the above organizations who intend to attend the congress in Turin, or who may desire to adhere to the congress in order to secure a copy of the *Transactions* of the congress without attending its meetings, will assist the committee by communicating their intentions to the secretary of the American Institute of Electrical Engineers.

A. I. E. E. Meetings..

The annual convention of the American Institute of Electrical Engineers will be held in Chicago on June 26, 27, 28, 29 and 30, 1911. The headquarters will be at the new Hotel Sherman. There will be a reception on Monday evening, June 26, and the technical sessions will open on Tuesday morning. The convention committee will have charge of the local arrangements. The members of this committee are as follows: Mr. Louis A. Ferguson, chairman, and Messrs. W. L. Abbott, B. J. Arnold, H. M. Byllesby, W. Lee Campbell, T. P. Gaylord, William B. Jackson, J. W. Johnson, John D. Nies, W. P. Sidley, B. E. Sunny, Fay Woodmansee, P. B. Woodworth and J. G. Wray.

The following is a partial list of the papers that will probably be presented: *Economical Design of Direct-Current Magnets*, by Mr. R. Wikander; *Catenary Span Calculations*, by Mr. W. L. R. Robertson; *Currents in Inductors of Induction Motors*, by Mr. H. Wiechsel; *Multiplex Telephony and Telegraphy by Means of Electric Waves Guided by Wires*, by Major G. O. Squier; *Electrolysis in Reinforced Concrete*, by Prof. C. E. Magnusson; *Induction Motor Design*, by Mr. T. Hoock; *The High-Efficiency Suspension Insulators*, by Mr. A. O. Austin; *The Electric Strength of Air*, by Prof. J. B. Whitehead; *Electrification Analyzed, and Its Application to Trunk-Line Roads*, by Mr. W. S. Murray; *Telegraph Transmission*, by Mr. F. F. Fowle; *The Cost of Transformer Losses*, by Messrs. R. W. Atkinson and C. E. Stone; *The Cost of Railway Electrification*, by Mr. B. F. Wood; *Induction Motor for Single-Phase Traction*, by Mr. E. F. W. Alexanderson; *Magnetic Properties of Iron at 200,000 Cycles*, by Mr. E. F. W. Alexanderson; *Electric Storage Batteries*, by Mr. Bruce Ford; *The Characteristics of Isolated Plants*, by Mr. P. R. Moses, and *Elevator Control*, by Mr. T. E. Barnum. There will also be two papers on educational topics.

PRESENTATION OF EDISON MEDAL.

The ceremonies attending the presentation of the Edison medal to Mr. Frank Julian Sprague will be held in the auditorium of the Engineering Societies Building, New York City, on Tuesday evening, May 16. The program as arranged will include the presentation of the medal and certificate of award to Mr. Sprague by Prof. Dugald C. Jackson, president of the Institute, and a number of addresses will be made indicating the result of Mr. Sprague's work along the lines of electric railway development and the use of electricity in the navy. Among the speakers and subjects will be: *The Development of the Electric Railway*, by Mr. W. B. Potter; *Social Results of the Introduction of the Electric Railway*, by Prof. F. H. Giddings; *The Relation of Governmental Control to the Development of Electric Railways and the Electrification of Steam Lines*, by Dr. George F. Swain. There will also be an address on the subject *The Results of the Use of Electricity in the Navy*. Representatives of the government, state, municipality, national engineering societies and civic organizations have been invited to participate in the presentation.

At this meeting the board of directors will submit its report for the fiscal year ended April 30, 1911, and the result of the membership vote for the offices to be filled for the ensuing administration year will be announced.

Program of the National Electric Light Association Convention.

The program of the National Electric Light Association convention provides for two sessions daily for four days. There will be a total of sixteen sessions, in a number of instances parallel sessions being held. There are twenty-four papers in the program and nearly forty committee reports. Below are given the general items of the program:

The first general session will be held Tuesday morning, May 30. On Tuesday evening the public-policy committee will present its report on the plan of welfare work. On Wednesday morning there will be three sessions, the technical, commercial and accounting respectively. In the afternoon will be held the second general session and the second accounting session. On Thursday morning the transmission section will hold its first session, the commercial section will hold its second session and the accounting its third session. In the afternoon there will be held the second technical session and the third commercial session. On Friday morning the transmission section will hold its second session, the technical its third and the commercial its fourth. The third general session of the convention will be held on Friday afternoon.

GENERAL SESSIONS.

At the first general session on Tuesday the items will include the address of President Freeman, the report of the committee on membership, of which Mr. H. H. Scott is chairman; the report of the committee on progress, of which Mr. T. C. Martin is chairman, and a paper entitled *Master and Men*, by Mr. Paul Lupke.

At the second general session, on Wednesday afternoon, Mr. Louis A. Ferguson will present a paper entitled *Electrical Exhibitions;* a paper entitled *Company and Company Section Bulletins* will be read by Mr. E. A. Edkins, and the following reports will be presented: "The Insurance Expert," by Mr. W. H. Blood, Jr.; "The *Bulletin* Question Box," by Mr. M. S. Seelman, Jr.; "The Library Committee," by Mr. Arthur Williams; "The Solicitors' Handbook," by Mr. Arthur Williams; the report of the secretary, by Mr. T. C. Martin, and the treasurer's report by Mr. George H. Harries. There will also be a topical discussion on the work of the company sections.

At the third general session, on Friday afternoon, the committee on rate research, of which Mr. John F. Gilchrist is chairman, will present its report; Mr. T. C. Martin will present the report of the committee on memorials, and Mr. Frank W. Frueauff will present the report of the committee on form of section organization. The following papers will be presented at this session: *Valuation of Properties as Related to Rates*, by Mr. W. F. Wells; *Reasons for Variations in Rates Under Varying Conditions of Operation*, by Mr. N. T. Wilcox; *The Standardization of Electrical Selling*, by Mr. Douglass Burnett, and *Economies in Operation Possible Through Time Study*, by Mr. L. B. Webster. As this will be the concluding session of the convention, the nominating committee will submit its report and the election of officers will take place. A vote will also be taken on certain changes in the constitution.

TECHNICAL SESSIONS.

At the first technical session, on Wednesday morning, reports will be presented by the following chairmen of the committees indicated: Mr. Farley Osgood, overhead-line construction committee; Mr. W. K. Vanderpoel, preservation of poles committee; Mr. W. L. Abbott, underground construction committee, and Mr. G. A. Sawin, meter committee.

At the second technical session, on Thursday afternoon, Mr. R. B. Williamson will present a paper entitled *The Ventilation of Turbo-Generators*: Mr. H. O. Troy will read a paper on *The Progress and Development in Self-Cooled Transformers*, and the following reports will also be submitted: The committee on prime movers, by Mr. I. E. Moultrop; the lamp committee, by Mr. W. F. Wells, and the committee on electrical apparatus, by Mr. L. L. Elden.

At the third technical session, on Friday morning, Mr. W. H. Blood, Jr., as chairman, will present the report of the committee on the grounding of secondaries, and papers will be presented as follows: Mr. P. M. Lincoln, *Grounding Low-Tension Circuits;* Mr. W. A. Layman, *Recent Important Improvements in Single-Phase Motors*, and Mr. F. D. Newbury, *Relation of Motor Load to Station Equipment.*

ACCOUNTING SESSIONS.

At the first accounting session, on Wednesday morning, Mr. John L. Bailey will present the report of the accounting committee, and papers will be presented by the following: Mr. John T. Brady, *Tracing Storeroom Material;* Mr. T. W. Buxton, *The Purchasing Department,* and Mr. Alex. Holme, *The Advantage of a Job-Cost System.*

At the second accounting session, on Wednesday afternoon, three papers will be presented as follows: *Handling Customers' Orders,* by Mr. R. F. Bonsall; *The Collection of Bills,* by Mr. E. J. Bowers, and *Electric-Vehicle Accounts as Applied to a Department of a Central-Station Plant,* by Mr. Herman Spoehrer.

At the third accounting session, on Thursday morning, a paper will be presented by Mr. Franklyn Heydecke on *General Office Accounting;* one by Mr. H. M. Edwards on *Depreciation,* and one by Mr. William Schmidt, Jr., on *The Extent to Which a Tabulating Machine Can Be Used in Accounting Work.*

COMMERCIAL SESSIONS.

At the first commercial session, on Wednesday morning, the following committees will submit reports through the chairmen indicated: "Electricity in Rural Districts," Mr. J. G. Learned; "Power," Mr. E. W. Lloyd; "Electric Vehicles," Mr. J. T. Hutchings.

The second commercial session will be held on Thursday morning and will be devoted to an executive session of the members of this section.

The third commercial session will be held on Thursday afternoon, when Mr. Clare N. Stannard will present the report of the committee on residence business and Mr. M. S. Sloan will present the report of the committee on industrial lighting. The report of the committee on improved wiring and equipment standards will be presented by Mr. M. C. Rypincki, and Mr. F. H. Gale will present the report of the committee on electric-heating, refrigeration and kindred appliance sales.

At the fourth commercial session, on Friday morning, Mr. C. W. Lee will present the report of the committee on electrical and central-station advertising; Mr. H. J. Gille the report of the committee on competitive illuminants, and Mr. T. I. Jones the report of the committee on the functions of a sales department.

TRANSMISSION SESSIONS.

The transmission section will hold its first session on Thursday morning. The session will be opened by the presentation of the report of Mr. H. L. Doherty on the April conference of the N. E. L. A. on the governmental control of water-powers; Mr. B. E. Morrow will read the report of the committee on protection from lightning, and Mr. Fred Darlington will present a paper entitled *The Utilization of Central Stations for Supplying Electricity to Operate Railroads.*

At the second session of the transmission section, on Friday morning, Mr. H. A. Wagner will present a paper entitled *A New Method of Reducing the Investment in Central-Station Boiler Plants,* and Mr. George H. Walbridge will present a paper on *Determining Cost of Production in Steam Properties Under Varying Conditions.* At this session there will be a topical discussion on methods of operating transmission systems.

Expiration of General Electric-Westinghouse Patent Agreement.

The agreement made by the General Electric Company and the Westinghouse Electric & Manufacturing Company in 1896, by which there was to be an exchange of licenses on overlapping patents, expired April 30, and will not be renewed, another such agreement being no longer considered necessary. Each company, however, still retains licenses of the other, which will expire with the patent or patents thus covered. The agreement was merely technical and related solely to the exchange of licenses. At the time it was made it was found that both companies held patents whose claims overlapped, and that each was therefore in continual danger of patent litigation. To avoid this it would be necessary for the companies' engineers to sacrifice many details which approached the line of demarcation between the patents in question, so that neither company enjoyed its full patent rights, and the art as a whole was handicapped. Many of the important patents covered by the agreement have since expired, although many others, such as those covering the incandescent lamp, are still in force. The Board of Patent Control, comprising representatives of both companies, went out of existence with the expiration of the agreement, but either company may license the other if similar conditions again obtain.

Organization of Scranton Company Section, N. E. L. A.

At a meeting held in Scranton, Pa., April 26, the Scranton Company Section of the National Electric Light Association was formed with an initial membership of fifty out of 300 employees. Mr. Duncan T. Campbell, general manager of the Scranton Electric Company, acted as temporary chairman until the organization was perfected. The officers elected were as follows: Mr. Frank Howard, superintendent of distribution, president; Mr. George Dewey, new business department, vice-president; Mr. H. H. Hammond, meter department, secretary; and Ely Harris, treasurer. During this month it is planned to hold a banquet in the Board of Trade rooms, to which the president of the N. E. L. A. and the executive secretary will be invited. Energetic efforts will then be made to increase the membership considerably, so that by the time of the annual convention over one hundred will be enrolled.

Meeting of Boston Section, A. I. E. E.

The regular monthly meeting of the Boston Section of the American Institute of Electrical Engineers was held at the Edison Building, Boston, April 26, with Mr. J. F. Vaughn in the chair. A paper was read on "Problems in Telephone-Traffic Engineering," by Mr. F. P. Valentine, general superintendent of traffic of the New England Telephone & Telegraph Company, Boston, Mass. Mr. Valentine discussed in considerable detail the engineering organzations and also reviewed the general methods of training technically educated men necessary in order to secure their largest usefulness. He cited various lines of attack which have been followed in endeavoring to improve the efficiency of the service as a whole, including the preparation and interpretation of peg counts, load curves, time tests of operating movements, study of advisable forms of phraseology and the training of operators for modern switchboard service. The paper showed that the telephone interests have been putting into practice for many years the principles of so-called scientific management and business efficiency which have lately received wide publicity, and the author pointed out that in the past four years wages of operators have increased 17 per cent as a result of traffic engineering progress, while at the same time if the methods of four years ago were in use to-day the annual cost to the company of handling its business would be increased $900,000.

Convention of the American Electric Railway Association.

The annual convention of the American Electric Railway Association will be held Oct. 9-13 at Atlantic City, N. J. A conscientious effort was made by the association to find a Western city possessing ample facilities for so large a gathering as usually attends the convention, but none could be found having the requisite accommodations available in October at the time of the convention. It is understood that the hotel association at Atlantic City will provide better meeting halls this year than were provided last year.

Meeting of Boston Edison Section, N. E. L. A.

The meeting of the Boston Edison Section of the National Electric Light Association, held on April 25, was devoted to a discussion of the work of the Boston Edison Laboratory, the following papers being read: "Standardization," by Mr. S. R. Keyes; "Laboratory and Station Testing," by Mr. C. L. Kasson, and "Steam and Coal Testing," by Mr. R. E. Dillon. At the conclusion of the meeting a visit was made to the company's laboratory, where a number of high-tension experiments were performed and the equipment and methods of the department further explained.

Mr. Keyes outlined the work performed by the standardizing division of the laboratory, discussing the equipment by which the accuracy of meters and instruments is tested, reviewing the advantages of the Clark and Weston cells as standards of potential, and touching upon the value of standardized resistances. The company has adopted the Weston cell as its primary standard, on account of the low temperature-voltage coefficient, and one of four such cells is sent half-yearly to the Bureau of Standards at Washington for verification. The oldest of these cells has been in use nine years, and the voltage has dropped only 0.056 per cent. The resistances are also checked periodically. Weston laboratory instruments are used as secondary working standards, Kelvin electric balances and Siemens dynamometers also being employed. The company has three storage batteries for constant potential work, and two precision series transformers. Extensive photometric work is also carried on by the department.

Mr. Kasson outlined the range of electrical testing handled by the laboratory, touching upon the instrumental comparisons, repair work on small apparatus, equipment and methods of testing employed. By means of transformers any current from zero to 1500 amp may be obtained, and any potential from zero to 75,000 volts. Among the articles tested regularly by the laboratory are watt-hour meters, instrument transformers, station shunts, indicating meters of various kinds, insulators, wires, switches, and samples of wood, asbestos, fiber, paper, rubber, marble and other materials. In addition to the foregoing lines of tests special investigations are frequently made.

The station testing includes meter checking, relay or circuit-breaker testing and setting, battery testing and trouble work. There are about 2500 alternating-current and direct-current indicating and integrating switchboard meters in the generating plants and substations, these being tested according to a prearranged schedule, so that the cost shall be uniform per month. About 850 meters per month are calibrated under the present schedule. Secondary standards are used in the station work. All relays in the same group are tested so far as possible in the same month. The relay test consists of applying current to the disconnected relay coils and observing the action and the time element under certain current values. The switches are then tripped out by operating the relays. The test is made by an artificial source of power, a variable load, ammeters and timing apparatus consisting of a telegraph sounder and a metronome. Occasional tests are made on the station storage batteries to determine the efficiency, output and condition of the battery. The test consists of preliminary discharge, final charge and discharge runs, during which readings are taken of the amperes and volts, together with the specific gravity, potential difference and temperature of the individual cells. Tests of vehicle batteries have also been made, including tests on the vehicles themselves. Meter, transformer and wiring troubles are also investigated.

In addition to the work in the laboratory and stations, the department does the electrical testing of cables and transmission lines. This work consists of high-potential, insulation and ohmic resistance tests, and tests of electrostatic capacity and electrolytic action. The high-potential tests are made on new cables to determine whether guarantees are fulfilled, and on old cables to eliminate weak spots. The test consists of applying an alternating potential of two or more times the working potential, between the conductors and between the conductors and the lead sheath, for periods of from five to thirty minutes. A portable testing set will shortly be added to the laboratory equipment which will permit the testing of 5 miles of cable at 30,000 volts. This will be mounted upon two 5-ton electric trucks. A considerable number of high-potential tests have been made on cables up to 10 miles long by the use of two station transformers, a transmission line, a turbine and the necessary auxiliary and exciting apparatus. A test made on a line to the Newton substation required the use of two 500-kw transformers at Newton and a 5000-kw turbine at the L Street generating station, both of which were loaded nearly to the full current rating. Insulation resistance tests are made by a standard resistance and galvanometer, together with a source of direct current. The cable resistance is determined by comparison with a standard 0.1-megohm resistance, and is given in terms of megohms per mile. The insulation resistance is sometimes measured directly by the use of a meggar. The ohmic resistance of cables or lines is measured by passing direct current over a long loop formed by two conductors, and measuring the drop in voltage and the current flowing. The electrostatic capacity of cables is measured by comparing the cable with a standard capacity with the aid of a ballistic galvanometer. In the electrolytic tests the difference and polarity of potential between the cable sheath and other surrounding media are measured, and the direct current actually flowing in the sheath is recorded. An ammeter and a multi-scale voltmeter equipped with a reversing switch are used, the observations being tabulated or plotted on a map.

Mr. Dillon described the methods of sampling coal for calorific and chemical tests, outlining the precedure of the laboratory in analyzing fuel. An important point brought out was an improved method of determining the amount of sulphur present in coal samples. The usual method, that of Eschka, requires about two days. The company has developed a method which enables the work to be done in about three hours, an important saving in view of the large amount of analytical work which has to be done yearly in connection with the fuel supply. The method consists of washing into a beaker the residue that is left in the bomb calorimeter after the heat-unit determination has been made, adding enough water to bring up the volume to 100 cu. cm. The solution is then filtered and barium chloride added, the result being a precipitation of barium sulphate. The solution containing the precipitate is then poured into an apparatus from which the percentage of sulphur in the sample can be read directly.

Boston Electric-Vehicle Publicity.

Continuing its policy of electric-vehicle development in the eastern Massachusetts field, the Boston Edison company has lately purchased advertising space six columns wide and a foot high in the Boston dailies, and has made a special effort to point out that the electric vehicle means a quicker, cleaner Boston, bringing old friends together and putting the business man practically in two places at once. In a recent advertisement the company emphasized the fact that the electric vehicle stands first for city and suburban motoring, for the reasons that its possible speed is greater than would ever be required in

such service; that its quick and simple handling in congested streets make it the ideal city car; that its appeal to women is undeniable in view of the absence of a chauffeur; through its facilities for comfortable transportation between home and office and to places of amusement, and on account of its continuous working powers without frequent repair-shop visits. The company admits the usefulness of the gasoline car for long-distance service, but points out that it indorses the electric vehicle for its own traffic requirements, as evidenced by the replacement of over fifty horses, buggies and gasoline cars with electric cars. When it is realized that the area to be covered extends from the Rhode Island state line as far north as New Hampshire, the purchase of these electric vehicles actually means that they have been proved capable of economically covering 550 sq. miles every day of the year. Actually, the replacement will affect over 150 horse-drawn vehicles and gasoline automobiles. The advertisement includes a drawing of a number of representative electric vehicles carried by Boston agencies operating in front of the Leif Ericson statue on Commonwealth Avenue. The company is maintaining a distinctly impartial attitude in its campaign, as regards different makes of vehicles.

Nebraska Electrical Association Convention.

The Nebraska Electrical Association held its fourth annual meeting April 24, 25 and 26 at the New Lindell Hotel, Lincoln, Neb. President B. C. Adams, general manager of the Lincoln Gas & Electric Light Company, called the first session to order about 11 a. m., and introduced Mr. George J. Woods, president of the Commercial Club of Lincoln, who said he was glad to welcome the Nebraska Electrical Association because its members were live wires and nearer chain lightning than any other convention members that came to Lincoln. He extended the courtesies of the Commercial Club rooms to the association while in the city. The reply to this address was made by Mr. H. A. Holdrege, of Omaha.

Secretary J. Bell, of David City (who was appointed by the executive committee to fill out the unexpired term of Mr. Frank McMaster, who left the State during the year), then presented in abstract the minutes of the last meeting of the association. The financial report showed a balance of $321.38 in the treasury and a generally prosperous condition. The secretary gave some of the details of the affiliation with the National Electric Light Association, which has had the effect of helping the Nebraska Association financially. The fiscal year of the association was changed to correspond with that of the National Electric Light Association. An auditing committee was appointed consisting of Messrs. George E. Shaberg, of Lincoln, and P. B. Egan, of Nebraska City. On motion of Mr. H. A. Holdrege the action of the executive committee in affiliating with the National Electric Light Association was approved. A nominating committee was then elected, consisting of Messrs. H. A. Holdrege, Patrick B. Egan and Crawford Kennedy, of Lincoln.

Secretary Bell, reporting on legislation, said that although many bills affecting electric-light companies had been proposed none had passed except a law providing for the punishment of persons tapping wires and stealing electricity. Mr. Holdrege, on behalf of the Omaha Electric Light & Power Company, invited the association to meet in Omaha next year.

Monday afternoon those in attendance were taken in automobiles by members of the Commercial Club of Lincoln for a ride around the city, ending at the Country Club.

The session on Tuesday began with a paper entitled "Coal Used in Nebraska," by Mr. R. E. Burger, of Fremont. He mentioned the points about coal which should be considered in its selection, such as cost of transportation, handling, ash, etc., and also touched on furnace design. Mr. Burger gave the general characteristics of the coals which are on the Nebraska market from surrounding states, and the results of certain tests showing Kansas coal to be the best. One general conclusion reached was that if coal giving the greatest number of heat units per dollar were purchased one would not be far astray.

Mr. L. J. Schwingel, of Holdrege, Neb., led the discusssion. Mr. F. H. Brooks, of Lincoln, emphasized the importance of having the furnace designed for the coal to be used. Mr. Holdrege discouraged the use of some low-grade fuels. Various members then gave figures on coal used per kw-hour in their respective plants.

A paper on oil as a boiler fuel was given by Mr. T. O. Kennedy, of Lincoln. The author described the various precautions necessary in burning oil economically and safely. He also gave figures on the relative values of coal and oil as fuel in Nebraska plants. Mr. F. H. Brooks told of an installation of oil burners in his company's plant, and the reason for its use. There then followed a brief discussion on engines operating with crude oil.

A committee was appointed to consider the question of dues from manufacturers and supply men in the Nebraska association. This committee consisted of two central-station men and two supply men, as follows: Messrs. L. J. Schwingel and Joel Roberts, of York; G. A. Seabury, of Kansas City (General Electric Company), and S. G. Peticolas, of Omaha (Westinghouse Electric & Manufacturing Company).

Tuesday afternoon Prof. G. H. Morse, of the Nebraska State University, read a paper on electric-lighting by-products in which he discussed some of the possibilities of utilizing the equipment of an electric-light plant for other purposes during low-load periods. He discussed storage of various kinds, including heat storage for local consumers' use on the principle of the fireless cooker. Under the head of electrolytic by-products he considered the manufacture of bleaching liquor for laundries, fertilizing compounds, sterilizing water, ozonizing air, manufacture of hydrogen and oxygen gases, etc. His paper closed with a dissertation on the manufacture of ice as a by-product. This was discussed by Messrs. L. J. Schwingel, J. R. Cravath, of Chicago, G. A. Seabury, and others, most of the discussion being on ice manufacture and electric cooking with stored heat.

Mr. C. J. Snyder, of Omaha, read a paper on new business, describing some of the methods used at Omaha and the success attained in wiring old houses, of which 1227 were connected in 1910. In the discussion Mr. Charles C. Smith, of Exeter, gave some of the plans he had used in promoting business in a small town. The subject was also discussed by Messrs. J. G. Boyd, S. G. Peticolas and B. C. Adams.

Tuesday evening the Lincoln Gas & Electric Light Company and the Lincoln Traction Company gave a dinner to the association at the Lincoln Hotel. Mr. Crawford Kennedy, of the Lincoln Gas & Electric Light Company, acted as toastmaster, and a number of informal speeches were made.

Wednesday morning's session was opened with a paper on "Household Motors," by Mr. S. G. Peticolas. The paper was devoted chiefly to the general utility motor for various household purposes. Mr. J. E. Schuff, of Lincoln, led the discussion, which was taken part in by Messrs. B. C. Adams, E. V. Capps, of Beatrice; J. G. Boyd, of the Columbia Incandescent Lamp Company; S. F. Dibble, of the General Electric Company; A. L. Pond, of the Ft. Wayne Electric Works; F. H. Brooks and others. Whether this kind of business should be handled by the central station or turned over to supply dealers was also discussed in detail.

Mr. C. M. Axford, of the General Electric Company, Kansas City, Mo., prepared a paper on "Street Illumination," which was read in his absence by Mr. Hain, of the same company. In it sign and outline lighting, which has been made more feasible for small towns than formerly by the tungsten lamps, was considered. Ornamental street lighting was also treated and the various arguments in favor of such lighting from the merchants' and citizens' standpoint were stated. Mr. Burger discouraged the ornamental street-lighting idea, and Messrs. Brooks and Schuff told of some Lincoln experiences with the ornamental-lighting system, which is not yet completed. Further ideas were advanced by Messrs. E. V. Capps, Joel Roberts, J. R. Cravath and C. C. Smith. Mr. Schwingel gave some information on cement ornamental posts.

The committee appointed to consider manufacturers' dues in the association recommended that these be placed at $2.50 per representative in attendance at a convention and $10 maximum for any one company. This decision of the committee was accepted. The following officers were elected: President, Mr. H. A. Holdrege; vice-president, Mr. F. H. Brooks; secretary-treasurer, Mr. J. Bell; executive committee, Messrs. L. J. Schwingel, C. C. Smith and J. E. Schuff.

Vice-president-elect Brooks then spoke a few words of appreciation of the services of Retiring President B. C. Adams. The secretary was instructed to convey to the Commercial Club the appreciation of the association for courtesies extended.

Southwestern Electrical Association Convention.

The seventh annual convention of the Southwestern Electrical and Gas Association, held at Houston, Tex., April 27-29, was marked by a record attendance of the central-station men of Texas and Louisiana, more than 600 delegates, associates and visitors having registered at the convention hall. The meetings were held in the session room of the beautiful new Houston municipal Auditorium, the principal floor of which was given over to an electrical show, the first in the history of electrical development in the Southwest.

The convention was opened Thursday morning by President W. B. Tuttle, of San Antonio, and its delegates were welcomed to Houston by Mr. W. H. Wilson, city attorney, on behalf of Mayor H. B. Rice. Mr. James Dillon, of Houston, responded for the association. Twenty-nine new member companies were admitted to the association, and honorary membership was conferred upon Prof. F. C. Bolton, of College Station, and Mr. H. S. Cooper, of Galveston.

In his official address President Tuttle took occasion to remark upon the present favorable tendency toward publicity in corporation management. Heretofore, he said, the public has seen only the collection side of the corporation's business and has often neglected to consider the huge outlays for operation, maintenance and new construction. It fails to realize, for example, that a corporation often puts back into a community more than its net earnings during the same year, while the coming of the company's service may greatly increase real-estate values and improve the healthful conditions of the homes it reaches. Although all other commodities have steadily risen in price, central-station service alone has decreased in cost, and the ride purchasable for a nickel has grown in value, satisfaction, speed and comfort from the horse car to the modern electric-railway car. Public-corporation managers, concluded Mr. Tuttle, are conducting "a square business in a square way," and the people are displaying willingness that the company should have the income which it rightly earns.

Mr. R. G. Soper, of Dallas, Tex., opened the regular program with a paper on the "Industrial Development of Fuel Gas," citing a number of commercial uses for such gas, and suggesting that gas solicitors adopt the tactics of electrical new-business salesmen in furthering the development of the fuel-gas business.

BOILER ECONOMY AND FLUE-GAS ANALYSIS.

At the afternoon session Mr. M. L. Hibbard, engineer for the San Antonio Gas & Electric Company, presented a paper on "Boiler Economy and the Application of Flue-Gas Analysis," showing the great savings in fuel burned which may sometimes be effected by intelligent use of the carbon-dioxide recorder. Mr. Hibbard discussed the chemical relations for complete combustion for both coal and oil, and analyzed the plant conditions under which flue-gas tests and analyses might be expected to show a fuel saving above the expense incurred in making the tests. Examples in which flue-gas analysis effected substantial fuel savings were also cited in the paper. In discussing the subject Prof. A. C. Scott, of the University of Texas, recounted comparative tests of a Dutch-oven and chain-grate stoker furnace, using in each both lignite and high-grade fuels. The Dutch oven showed superior results using lignite of 8000 units to 9000 units fuel value, and attained a flue-gas content of 8 per cent CO_2 with hand firing, while the modern grate is much below this with the same low-grade fuel. Mr. F. G. Frost, of Houston, told of the results obtained there with oil burners, attaining a boiler efficiency of from 12 per cent to 14 per cent, beyond which the magnitude of other losses decreases the net input into the heating surface. Mr. H. S. Cooper, of Galveston, declared that the type of oil burner employed in reality affects the results less than the character of the draft and the spraying action of the fuel to be obtained.

RAILWAY RETURN CURRENTS.

Mr. E. E. Nelson, of the North Texas Traction Company, of Ft. Worth, next discussed the "Investigation and Care of Return Railway Circuits." Mr. Nelson's remarks were confined chiefly to bonding between rails. Many troubles in electric-railway operation, he declared, can be traced to poor bonding. The resistance of a steel rail in ohms, said Mr. Nelson, equals 0.6 divided by the weight of the rail in pounds per yard, and its carrying capacity, in equivalent circ. mils of copper cross-section, equals 16,000 multiplied by the weight of 36 in. of rail. For bond contact surfaces a current density of 100 amp per square inch is taken as good practice. A fishplate well bolted will carry easily 50 amp. Mr. Nelson gave some practical hints about the selection and installation of bonds, fishplates and other track equipment for electric-railway duty. The bonds must be flexible and free, so that they can move without damage with the "giving" of the rails. Mr. Nelson recommended the use of short bonds under the fishplates, where the copper is protected from thieves. In drilling holes for bonds he warned against getting oil or other lubricant on the contact surfaces. Where there is large leakage of current from the rail to the ground the base of the rail is more rapidly destroyed than the tread, especially in case the ties have been impregnated with preservative salts, such as chloride of zinc. Bond resistances are usually expressed in terms of equivalent rail lengths. He said that a No. 0000 bond on a 70-lb. rail in good condition will show a resistance equal to that of from 1 ft. to 2 ft. of rail.

In the discussion which followed Mr. M. L. Hibbard, of San Antonio, told of usng a city arc circuit for conducting voltage-drop tests in a street-railway system, the lamps being lowered from their brackets as for trimming, and contact made with their wires through test jumpers. At the station the two sides of the arc circuit were linked through a voltmeter. Mr. H. S. Cooper pointed out that the leakage from a return conductor to the surrounding earth is a function of its potential difference from the surrounding medium rather than inversely as its carrying capacity, as might be intimated. Mr. W. L. Wood, of Texarkana, suggested the application of solder with a blow torch around bond terminals, sealing the contact against the entrance of moisture. Objections to this method were raised by Mr. Nelson, who pointed out the disadvantages of heating the bonded joint after completion.

STEAM CONSUMPTION OF WATER-GAS PLANTS.

A paper on the steam consumption of moderate-sized water-gas plants by Mr. L. B. Moorhouse, of San Antonio, was of interest to central-station men who take advantage of the combined boiler operation of water-gas and electric plants. A water-gas plant producing 1,000,000 cu. ft. of gas per day, said Mr. Moorhouse, would need 1500 lb. of steam per hour for the generators, or about 45.5 boiler-hp, 38.6 hp for the blower, 1.97 hp for the exhauster, and about 14.5 hp for the pumps. Allowing for leakage and radiation, the total boiler-hp required would be at least 125. The presence of water in steam going to the generator will decrease the efficiency of the gas-making process. Of course, several of the auxiliary uses for steam in the above plant might be replaced to advantage by electric motors, improving the efficiency above that of small steam engines and providing motor loads for the electrical end of the combination plant.

QUESTION BOX.

One of the characteristic features of the Southwestern convention of great value to operating men is the "Question Box," under the editorship of Dr. A. C. Scott, professor of electrical

engineering at the University of Texas. This year 217 electrical questions have been answered, in many instances by several companies, and all the replies arranged in printed form in the handsome 110-page souvenir program issued by the association. Special interest is evidenced in electric meters, nearly sixty questions having been propounded on this subject. On Thursday afternoon a brief discussion of several unanswered queries in the Question Box brought up the subject of boiler compounds and water purification. Mr. J. E. Carroll, of Beaumont, declared that in his experience the design of a boiler often affects the deposit of scale more than the water used, a properly constructed boiler depositing the scale where it can be removed in the process of blowing off. Mr. M. L. Wood, of Texarkana, said that he had found feed-water heaters of little or no service in removing scale-forming ingredients from feed water. Mr. W. B. Tuttle, of San Antonio, said that even a small plant having trouble with boiler scaling might benefit from the installation of a water-purifying apparatus. The comparative advantages of surface and barometric condensers under different conditions of service and water supply were then discussed by Messrs. E. L. White and C. C. Douglass.

ACCIDENT PREVENTION.

Beginning the Friday morning session, "The Cause and Prevention of Accidents" was the subject of a paper by Mr. C. W. Kellogg, Jr., manager of the Texas securities department of Stone & Webster. Mr. Kellogg spoke of the large percentage of gross earnings frequently paid out by public-service companies to settle accident claims, citing an electric-railway case where the proportion reached the high total of 19 per cent. Damages arising from accidents have been especially expensive in Texas. All street-railway accidents, said the speaker, may be traced to the failure or unexpected behavior of either equipment or the human element, the majority being step accidents of the latter kind, as shown by detailed reports which Mr. Kellogg submitted. Open cars, for example, have 59 per cent more accidents than prepayment cars. Types and positions for fenders, gongs, motormen's step-mirrors and other safety devices were also discussed. Mr. Kellogg denominated as fallacies the notions that new men are more likely accident breeders than old employees, and declared that street-car train men in general are possessed of a good order of intelligence. Tables which he produced showed that while the minimum of accidents per trainman is attained in the first month, and not again until the sixth year of service, the majority of accidents happen during the period between the seventh and twelfth month. Instruction for trainmen and minor attentions to their comfort were recommended as increasing the satisfaction and loyalty of employees. Means of attracting the public's attention to safety measures and precautions were also touched upon. In discussing accidents on lighting-company lines, more of which in Texas, said Mr. Kellogg, result fatally than in the case of the street railways there, the speaker advocated better maintenance and inspection and the adoption of safety precautions, such as arc-lamp cut-out hangers, wider pole-pin separation on cross-arms, grounding of transformer secondaries, etc. Mr. Kellogg also urged against too light a regard for the dangers of live 2200-volt alternating-current distribution wires. In the discussion which followed points of railway-accident prevention and defense were brought up by Messrs. T. C. Brown, of San Antonio; W. L. Wood, of Texarkana, and E. D. Kelly, of Terrell. Mr. J. A. Walker spoke of the difficulties sometimes experienced in grounding secondaries effectively in the dry climate of parts of Texas, and Mr. G. H. Cushing, of San Antonio, reported good results with galvanized-pipe grounds driven alongside the pole, the butt of which, he said, naturally holds moisture. Such grounds are invariably able to blow a 3-amp fuse on 110 volts even in his dry climate, which he takes as a good standard of grounded connection.

DEVELOPMENT OF THE MOTOR-SERVICE BUSINESS.

In a paper on the development of motor-service business Mr. P. A. Rogers, commercial agent for the Dallas Electric Light & Power Company, pointed out that the small motor customer using up to 25 hp exists in by far the greatest number and, although usually technically unqualified to make his own selection of apparatus, his load is in the aggregate important and desirable business for the central station. Mr. Rogers referred to newspaper advertising as a means of reaching this class, but declared the only effective method to be personal solicitation, applying skilled salesmanship and electrical knowledge to the customer's problems. The author recommended that the solicitor make his study of the conditions and determine their solution before submitting any proposition to the customer. Such a proposition should be stated in the simplest form possible, avoiding leaving the selection from a number of proposals to the customer, who may become confused and choose equipment not to his own best interests. While Mr. Rogers laid out no detail of procedure for working up motor-installation cases he urged personal solicitation and education of the prospective customer as the most important requirement in building up a motor-service business. In the discussion which followed the subject of motor drive of cotton gins as a desirable central-station load was brought up by Messrs. W. A. Guthrie, of San Angelo; E. D. Kelly, of Terrell; C. H. Cushman, of San Antonio, and C. W. Kellogg.

With Dr. Scott presiding, the Question Box discussion was again opened on the subject of producer plants, particularly those using Texas lignite as fuel. While several manufacturers have withdrawn their apparatus and certain plants have ripped out lignite producers or are now using bituminous fuel, several operators who have had from three to four years' experience with lignite producers expressed themselves as thoroughly satisfied with this form of motive power, declaring it to be, in their estimation, the future form of power for the Southwestern States, where great deposits of lignite are available at low cost.

Mr. John I. Beggs, formerly president and general manager of the Milwaukee Electric Railway & Lighting Company, who was a visitor to Houston Friday afternoon, was invited to address the convention. Mr. Beggs spoke appreciatively of the responsibilities of public-utility corporation management, expressing the warmest interest in the work of the Southwestern association and the properties represented by it.

LEIGHT-WEIGHT CAR CONSTRUCTION.

A paper on the construction and operation of light-weight cars in Houston, by Mr. R. T. Sullivan, superintendent of the local company, was read by Mr. David Daly, general manager of the company, in Mr. Sullivan's absence. Mr. Sullivan's paper described the reduction in weight of 30 per cent attained by the new Houston cars weighing only 30,000 lb., which seat forty people. The economy effected by this decrease in weight, wrote the author, is also felt in power-plant investment, power consumption, maintenance of equipment and rolling-stock investment. Mr. Sullivan's paper considered briefly the determination of the proper size, weight and headway for cars operating under various conditions of service in the same city, and suggested that a double standard of equipment might be found best for the ideally operated city system. Mr. R. B. Stichter, general manager of the Texas Traction Company, called attention to the great significance of the saving effected by weight reduction in the case of interurban cars having long daily runs, where the energy saving would be expected to amount to 100 watt-hours per ton-mile, besides consequent reduction all along the line of investment, operation and maintenance.

Mr. W. H. Riblet, superintendent of manufacture of the Houston Gas Company, closed the technical program on Friday afternoon with a paper on "Naphthaline," detailing the process of manufacture of illuminating gas at Houston.

ELECTION OF OFFICERS.

On Saturday morning the nominating committee, consisting of Messrs. C. H. Dunbar, E. S. Fletcher, L. B. Moorehouse and Thomas Cook, proposed the following officers of the association for the ensuing year, their election being unanimously voted by the convention:

President, Mr. J. E. Carroll, Beaumont; first vice-president, Mr. E. T. Moore, Dallas; second vice-president, Mr. D. G. Fisher; fourth vice-president, Mr. H. M. Moore, Austin. Mr. Dan G. Fisher, of Dallas, was re-elected secretary. The following

were chosen members of the executive committee: Messrs. W. B. Head, Stephensville; W. B. Tuttle, San Antonio; J. B. Carroll, Beaumont; A. E. Judge, Tyler; E. D. Kelly, Terrell; G. H. Clifford, Ft. Worth; E. T. Moore, Dallas; D. G. Fisher, Dallas; W. L. Wood, Texarkana, and J. E. Johnson, Stamford.

CONVENTION HALL AND ELECTRICAL SHOW.

The convention was unusual in having for its headquarters and meeting place the large Auditorium Building. Besides the sessions and the electrical show in the same building, comfortable reception-rooms were arranged in the spacious lobbies, from which the general public was excluded. Although the local hotels were comfortably taxed by the presence of the convention, the association headquarters were maintained at the Auditorium Building. The streets leading to this structure were brightened by double festoons of electric lamps, and at several points in the city electric signs bade welcome to the delegates.

The electrical show, held under the auspices of the association, opened in the large main hall of the Auditorium on April 27 and continued until April 29, during the days of the convention. The exhibits at this, the first electrical exhibition of the kind in the Southwest, embraced domestic electrical appliances for the general public as well as equipment and supplies of interest to operating men. The decorative scheme included a huge star and crescent, 20 ft. in diameter, at the center of the ceiling, formed by the solid massing of several hundred frosted carbon lamps. From this centerpiece there depended in all directions streamers of similar frosted lamps. Local popular interest was keen in the electrical show, to which no admission was charged, and the exhibit space was thronged during the hours the doors were open. The electrical show arrangements were in charge of a local committee, of which Mr. M. B. Wheeler was chairman, the other members being Messrs. C. A. Newning, David Daly, Clarence George, A. J. Binz, J. S. Bonner, F. E. Ebersole, Lee Johnson, E. G. Pike, W. H. Chapman, G. C. Bradley, L. C. Dilzell and H. W. Bates.

ENTERTAINMENT.

The entertainment committee wisely adopted the plan of arranging its recreation features following the principal sessions of the convention. A number of ladies visited Houston and were entertained on Thursday afternoon at the Country Club and in the evening at a reception at the Electrical Show. On Friday evening the Sons of Jove rejuvenation was held. On Saturday there was a boat trip down the Houston ship channel to the famous San Jacinto battleground, where a shore dinner was served. On Sunday the delegates visited Galveston over the line of the new interurban railway, inspecting the midway power house for the road and the great concrete causeway which will carry the cars across the waters of Galveston Bay. At Galveston automobiles were ready to take the party on a tour of the island.

Pacific Coast Meeting of the A. I. E. E.

The meeting of the American Institute of Electrical Engineers held in Los Angeles from Tuesday, April 25, to Friday, April 28, was highly successful. The attendance totalled 189 members and 134 guests. On the opening day the registration exceeded 200.

At the Tuesday morning session the meeting was called to order by Chairman J. E. Macdonald, of the Los Angeles Section, who introduced Mayor George Alexander. In welcoming the visitors to the metropolis of southern California, Mayor Alexander stated that the city would ultimately have available about 100,000 hp for distribution through its own system. The first paper on "Transmission Applied to Irrigation," by Messrs. O. H. Ensign and James M. Gaylord, of Los Angeles, was read by Mr. Ensign, followed by a paper on "Transmission Systems from the Operating Standpoint," by Mr. R. J. C. Wood, of Los Angeles. The discussion of the two papers was combined and was carried on by Messrs. A. H. Babcock, C. L. Cory, E. F. Scattergood, Paul M. Downing, Ralph Bennett, C. W. Koiner, L. J. Corbett, J. A. Lighthipe and Ralph D. Mershon.

TRANSMISSION APPLIED TO IRRIGATION.

In the paper by Messrs. Ensign and Gaylord the conditions leading to the use of transmitted energy for pumping in connection with irrigation projects were stated to be as follows: (1) In some cases high lands which cannot be reached by the diversion works constructed for a gravity system can be reached by pumping water from the gravity canals into canals feeding such high-land reservoirs. (2) The irrigated area may be advantageously extended by pumping from wells, thus drawing on underground sources and tending to keep the water plane down, this plan being particularly desirable in certain cases. (3) Pumping may also be applied to the drainage of low land, water being pumped to either irrigation or waste ditches.

The authors described two irrigation projects carried out by the United States Reclamation Service. One of these, known as the Minidoka project, involves a rock-filled dam with concrete core located near the foot of the rapids in the Snake River, and the other project is located on the Salt River, where a storage reservoir, diversion works and canals are constructed in connection with the well-known Roosevelt dam. The electrical generating equipment on the Snake River consists of five 1400-kva, three-phase, 60-cycle alternators directly connected to vertical-shaft turbines. The energy from this station is transmitted at 33,000 volts over a transmission line 22 miles in length to three pumping stations, each having a lift of 31 ft. Pumping station No. 1 contains five pumps, four for lifting 125 cu. ft. per second and one 75 cu. ft. per second. Station No. 2 contains four pumps, each designed for 125 cu. ft. per second. Station No. 3 contains three pumps, two for 125 cu. ft. per second and one for 75 cu. ft. per second. All of the motors for driving the pumps are of the vertical-shaft, self-starting synchronous type, designed for operation at 2200 volts. The rotors are provided with squirrel-cage windings to permit starting them as induction motors.

The estimated monthly cost of operating the pumping system, based on actual cost during the season of 1910 exclusive of ditch tending, amounted to 78 cents per acre per season. This estimate was based on a depth of 3 ft. of water during the year over an area of 50,000 acres.

The energy generated at the Roosevelt dam will be used in pumping to prevent the rise of ground water to a point dangerously near the surface, and to supplement by means of drawing on the underground supply the water stored in the reservoir and delivered by the natural flow of other streams. It is estimated that when finally completed there may be over 100 pumping plants similar to plants that are now installed on the Prima Indian reservation, where there are ten wells and pumping equipment costing about $105,000, which serve for irrigating about 10,000 acres of land.

THE OPERATION OF TRANSMISSION SYSTEMS.

In the paper by Mr. Wood the requirements for the successful operation of transmission systems were stated to include the following elements, namely: The requisite amount of power must be transmitted with reasonable voltage regulation, interruptions must be reduced to a minimum, flexibility of operation should be assured and ease of repair must be maintained. The author claimed that the permissible amount of regulation is determined not only by financial considerations, but by the conditions surrounding the transmission of energy, such as the interconnection of the stations at which the energy is produced. He stated that when a transmission line is part of an interconnected network and energy may be transmitted in either direction the voltage regulation must be low. In case energy is supplied to a transmission system from hydroelectric and steam plants located at opposite ends of the line, the transmission line should operate with only one-half the voltage regulation that would be permissible if it were a one-way transmission.

In discussing the reliability the author stated that in designing a transmission line it is best to base the calculations on the worst climatic conditions recorded over at least thirty years

and to allow a factor of safety of 2.5. In designing switch installations abundant space should be provided around the galleries and busbar compartments. The lack of a few extra feet between switches may necessitate an entirely new building in case additions are made within a few years. The author expressed the opinion that in many large systems greater reliability could be obtained by dividing the system into several parts, limiting the amount of power to about 50,000 kw per part.

Discussion.

Prof. C. L. Cory in discussing the paper of Messrs. Ensign and Gaylord expressed his gratification at the apparent attainment of a standard in irrigation work which approximated that which prevailed in other branches of energy transmission. It was evident from the nature of the service, however, that more time would be required for acquiring a proper load and getting a proper financial return, due to the fact that the development of the agricultural resources would be comparatively slow. In New Mexico irrigation would not be required before February and the demand would not continue over five months out of the year. Mr. Corbett stated that in the Spokane districts the irrigation season was specified in most contracts as 100 days. He considered the plan for pumping out the surface water as a valuable feature in irrigation, as if the water was permitted to remain too long the soil became "sour."

In the discussion of Mr. Wood's paper Mr. Downing said that in the bay districts the lightning trouble was not so serious as the leakage due to deposits on the insulators causing flashovers.

Mr. Lighthipe, referring to early experience in transmission and distribution, said it was difficult to predict what would be required in the future as the area of distribution increased, but that a voltage of 150,000 might be reached.

ELECTRIC FURNACES.

"The Refining of Iron and Steel in Induction-Type Furnaces" was the title of a paper by Mr. C. F. Elwell, which in the absence of the author was read by Mr. C. W. Koiner. Mr. E. W. Paul, in discussing the paper, said that steel is now sold to comply with a specification requiring a chemical analysis of the product. In the Bessemer process this is a matter of guesswork, while the open-hearth process more nearly meets the conditions. The electrical process eliminates most of the phosphorus and appears to avoid the possibility of chilling a charge, which is an important advantage.

Mr. J. J. Frank said that in investigating an arc furnace he had found that one of the chief difficulties is in handling the electrodes. These are 8 in. x 24 in. in size, and in case of breakage the carbon falling into the mass adds to the impurity of the metal. There is another type of induction furnace in which the primary winding is a copper tube which was cooled by water passing through it. Professor Sorenson was of the opinion that a special type of transformers would be required for a furnace of the type described. Mr. Budd Frankenfield did not consider the smelting project merely an off-peak proposition. It might be found desirable to build up an industry of this character to utilize the power from the Owens River aqueduct, rather than build an extensive network for the distribution of small amounts of power.

A mathematical paper by Mr. George A. Campbell, entitled "Cisoidal Oscillations," was abstracted by Professor Cory. Other papers presented were the following: "Continuity of Service in Transmission Systems," by Mr. M. T. Crawford; "Electricity in the Lumber Industry," by Mr. E. J. Barry; "A Power Diagram Indicator for High-Tension Circuits," by Prof. Harris J. Ryan; "New Automatic Telephone Equipment," by Mr. Charles S. Winton; "Auto-Manual Telephone Systems," by Mr. Edward E. Clement; "Some Recent Developments in Railway Telephony," by Mr. Gregory Brown. The papers were well discussed, the discussion on the telephone papers being particularly complete. Below are given brief abstracts of the papers by Messrs. Crawford and Barry.

CONTINUITY OF SERVICE IN TRANSMISSION SYSTEMS.

In his paper Mr. Crawford reported the results of a number of years of operation of the Snoqualmie Falls transmission system of the Seattle-Tacoma Power Company. Up to 1910 the generating station contained 12,000 kw in generators and 15,000 kw in step-up transformers, and during 1907, 1908 and 1909 the transmission line was operated at 30,000 volts. In December, 1909, the transmission emf was raised to 60,000 volts. In November, 1910, an additional generator rated at 8750 kw was installed, together with 7500 kw in transformers. The transmission line consists of several sections, a straight-away transmission from the generating station to Renton, with branches from this point to Seattle and Tacoma. From Snoqualmie Falls to Renton, over a distance of 20 miles, there are two pole lines. From Renton to Seattle, a distance of 13 miles, there are also two pole lines. From Renton to Tacoma there is a single-pole line having a length of 26 miles, and another having a length of 34 miles. An independent single-pole line extends from Snoqualmie Falls to Everett, a distance of 40 miles. Other short branch lines are in use, the total length of transmission being 172 miles. Three-phase transmission circuits are used throughout, with 7-ft. x 9-ft. spacing, and also 7-ft. equilateral triangular spacing. The wire from Snoqualmie Falls to Renton is No. 0000 seven-strand aluminum, from Renton to Seattle and Tacoma the wire is No. 00 seven-strand aluminum, and No. 4 solid copper wire is used on the other circuits. For 30,000-volt operation the insulator employed was of the triple petticoat porcelain type, 6 in. in diameter, placed on locust-wood pins impregnated with paraffine. For 60,000-volt operation the insulators are of the four-piece brown-porcelain type, mounted on malleable cast-iron pins. When operated at 30,000 volts use was made of multi-gap lightning arresters with series resistance. When the equipment was changed to 60,000 volts aluminum-cell electrolytic lightning arresters were installed at each end of each line.

During the latter part of 1907 considerable trouble was caused by the burning of wooden pins. The threaded tops of these pins, which had been in service for nearly seven years, were softened to pulp, apparently by the action of nitric acid formed from the air and moisture by leakage currents. After the injured pins were replaced by malleable-iron pins the system gave practically continuous service during the year 1909. Since the equipment was changed in 1909 for operation at 60,000 volts, there have been only two shut-downs out of twenty-three cases of trouble, thereby showing that the method of operation is equally successful at the increased voltage as at the lower voltage. During the years 1907, 1908, 1909 and 1910 the following service interruptions occurred: Ten due to defective line construction, failure of switches, insulators, etc.; six to failures in transformers; fourteen to malicious interference, blasting stumps, etc.; eighteen to winds, fires, floods, fogs, etc.; two to lightning; three to mistakes by employees, and thirteen unknown, the total being sixty-six. Of this total fourteen represented complete shut-downs, seven of which occurred during the half of 1909 when the system was run on one line during working hours in order to permit the reconstruction for higher voltage. During the other three and one-half years the average was two cases of shut-down per year.

ELECTRICITY IN THE LUMBER INDUSTRY.

An outline of the uses to which electricity is put in the mills of the Potlatch Lumber Company, at Potlatch and Elk River, Idaho, was given in the paper by Mr. Barry. The Potlatch mill, with an equipment capable of producing 750,000 ft. of lumber per day, is one of the largest in the West. The generating equipment at Elk River consists of one 800-kw, 600-volt, three-phase, 60-cycle turbo generator and a 500-kw unit of the same type. At Potlatch there is a 1500-hp Corliss engine belt-connected to a line shafting for the sawmill and a 1100-hp Corliss engine for driving the planing mill. The exhaust from the 1500-hp engine operates a low-pressure turbine, which drives an 800-kw, 60-cycle turbo-generator, which supplies energy for driving the machinery in a box factory, a blower on the sawdust conveyer and the machinery in the machine shop, car shop and pump houses. It also supplies energy for lamps in the mill and town, and for operating a 200-hp motor in a local brick-making plant. Use is made of storage-battery locomotives for conveying the lumber from the sawmill to the dry kiln, and from the dry kiln to the planing mill.

Meeting of the Electric Vehicle Association of America.

The regular monthly meeting of the Electric Vehicle Association of America was held in the Engineering Societies Building, New York City, April 25, Mr. C. A. Littlefield presiding in the absence of President Blood and Vice-president Williams. The secretary announced that the present membership of the association is 181, and that an electric-vehicle parade will probably be held during the week beginning May 29, while the convention of the National Electric Light Association is in progress.

The paper of the evening was presented by Mr. R. L. Lanphier, of the Sangamo Electric Company, and was entitled "The Ampere-Hour Meter for Electric Vehicles." The author described the two types of ampere-hour meter built by his company for automobile service, both of which are familiar to our readers. The paper was discussed by Messrs. C. A. Littlefield, of the New York Edison Company; W. F. Kennedy, formerly of the Studebaker Automobile Company; G. E. Russell, of the General Electric Company; R. L. Lloyd, of the Philadelphia Electric Company; R. M. Lloyd, of the General Vehicle Company, and J. Bradshaw.

Mr. Bradshaw was of the opinion that the combination of an ampere-hour meter and the hydrometer would be an excellent means of keeping vehicle batteries in good condition. He said that there is still a field for some form of indicating hydrometer which will, in connection with an ampere-hour meter, make the storage battery much more serviceable than it is at present. He also stated that the ampere-hour meter was not serviceable for enormous ranges and that while the watt-hour meter was accurate to within thirty-five times its lowest range of rating, the ampere-hour meter was not.

Mr. Lloyd stated that the General Vehicle Company found when using the ampere-hour meter that if 8 per cent more charge was put in the battery than was taken out the batteries were kept in good condition. It is very easy to ascertain by means of the ampere-hour meter when the battery is fully charged. His company rates its batteries at 6 hours' discharge rate, and charges them at a 6½-hour rate.

Los Angeles Aqueduct Power Utilization.

Inasmuch as the recent charter amendments adopted in Los Angeles provide for the establishment of a bureau of electric service by the city, under the supervision of the Board of Public Service Commissioners, to develop and distribute electrical energy produced by the Los Angeles aqueduct now under construction, Mayor Alexander, of that city, urges the immediate organization of the bureau. The Mayor has addressed a letter to the public service commissioners in which he says that the work should be taken up at once. There are four principal points along the aqueduct at which electrical energy may be advantageously developed.

The first site mentioned is at San Francisquito No. 2, where a maximum of 32,000 hp may be developed. The cost of the plant, including the transmission to the city from this point, would be about $2,300,000, which would leave $1,200,000 of the authorized bond issue of $3,500,000 for the distributing system.

San Francisquito No. 1 is named as the second site. Here it is possible to develop a maximum of about 60,000 hp, and the cost of the plant would be about $3,300,000, leaving for the distributing system only $200,000.

At San Fernando about 9000 hp could be developed. The cost for a plant here would be $750,000, leaving for the distributing plant $2,750,000. However, it would be hardly practicable to erect a distributing plant, at the expense required, for the distribution of this comparatively small amount of energy.

The fourth site is at Haiwee, including Cottonwood Creek Nos. 1 and 2 and Division Creek. The amount of energy available is about 10,000 hp and the cost of the plant would be $1,500,000, leaving for the distributing system $2,000,000.

Mayor Alexander estimates that the cost of a complete distributing system for the city will be about $4,250,000. With complete development of the hydroelectric power at all points an auxiliary steam plant would not be necessary, but with only partial development $500,000 would probably be allowed for an auxiliary plant. The amount of electrical energy consumed in Los Angeles, exclusive of that for railway purposes, is about 20,000 hp. While disclaiming expert knowledge, the Mayor gives it as his opinion that the city should proceed with such partial development of the hydroelectric power of the aqueduct and the transmission of energy to the city as would provide for present needs and those of the immediate future, using the balance of the proceeds of the power bonds now voted toward building or acquiring a distributing system. If this plan is followed an additional bond issue of about $3,500,000 will be required, allowing about $500,000 for an auxiliary steam plant. The Mayor believes that the citizens would vote for the additional bond issue without hesitation. It is therefore urged that the electric service bureau be organized at once and proceed to formulate a plan for a complete distributing system, relying upon the people to back it up in the enterprise. Action on this matter was temporarily deferred until an opinion can be had from the city attorney defining the authority of the Board of Public Service Commissioners in the matter.

Sample Machinery for Determining Electrical Equipment of Panama Locks.

The *Canal Record* of April 12 contains some interesting information about the placing of awards by the Isthmian Canal Commission for sample machines to be used in operating the Stoney gate valves and the cylindrical valves to be employed in the operation of the locks on the Panama Canal. These sample machines will be tested on the Isthmus under conditions approximating those of actual use, and upon the results of the tests will depend the awarding of the contracts for the whole quantity, which will cost about $905,000. Tenders for this machinery were opened on Sept. 16 last, but the bids for the principal items were so high that no awards were made. At the prices then offered the material now to be furnished would cost more than $1,400,000. New bids were opened on Feb. 25, and, including some from foreign manufacturers, twenty-two bids were received in response to the second advertisement. The difference in the prices offered is about $500,000.

The total number of Stoney gate-valve machines to be used in the locks is 114, while the number of cylindrical-valve machines required will be 118. Both types will be operated by electric motors, and, for the purpose of testing, sample motors have been purchased from the Allis-Chalmers Company, Westinghouse Electric & Manufacturing Company, General Electric Company (two on an alternative bid), and Allmänna Svenska Elektriska Aktiebolaget (General Electric Company of Sweden), the last award being conditional. Two sample motors have been purchased from each of the manufacturers named.

Two electric limit switches for the Stoney gate-valve machines and two for the cylindrical-valve machines are to be purchased from each of the following bidders: Cutler-Hammer Manufacturing Company, Westinghouse Electric & Manufacturing Company, General Electric Company, and Allmänna Svenska Elektriska Aktiebolaget. The total number of limit switches to be purchased under this contract is 144 for Stoney machines and 118 for cylindrical machines.

Electricity in Ice Plants.

Mr. Augustus C. Smith, sales engineer of the Cataract Power & Conduit Company, Buffalo, N. Y., read a paper on ice making in Chicago on April 26 at a joint meeting of the Chicago Section of the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers. In beginning his paper Mr. Smith pointed out that one of the problems to solve in applying electric energy to ice making is the question of using pure or distilled water. The question

asked is: If it is necessary to boil the water, then why not produce live steam and operate steam-driven ammonia compressors, thereby getting power as a by-product at small cost? Another point to be considered in electrical operation is flexibility of speed control in the electric motor as compared with the steam-driven compressor. This consideration is more serious because in most cases the motor available for the central-station energy is of the alternating-current induction type.

Where pure water is obtainable the plate system of ice making has helped to solve the first of these problems by taking the water as received and applying proper systems of filtration and agitation. The author proceeded to describe a 100-ton electrically driven ice plant in Buffalo using the plate system (see also *Electrical World*, March 30, 1911). At first two-speed and three-speed induction motors were applied to ammonia compressors, but this arrangement, even with switching devices changing the poles of the motor and motor pulleys of different sizes, did not provide the flexibility of speed necessary. Finally the standard type of variable-speed induction motor was applied, having external resistance control and giving a flexibility of speed range for the compressor equal to that of the steam-driven compressor, but at the cost of less efficiency at reduced speeds. The power-factor, however, remains practically constant at all speeds. Therefore, in ice plants where during certain seasons of the year there is a wide difference in output and variable-speed motors are used better economy can be obtained by having two or more compressor units proportioned with relation to each other according to the local operating requirements.

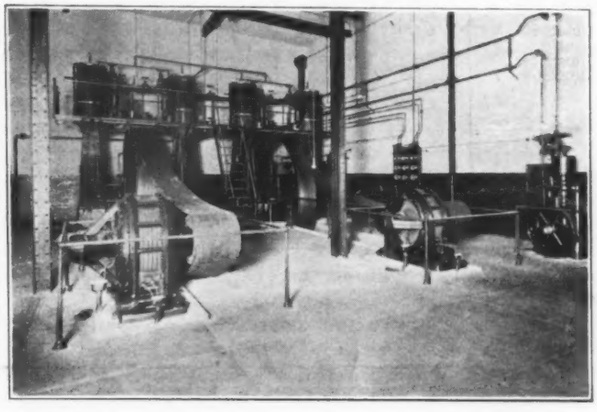
In the engine-room of the ice plant using the plate system, the compressor, rated at 100 tons output daily, is driven by a 200-hp, three-phase, 25-cycle, 2200-volt induction motor. The external resistance control in the secondary of the motor gives a range in speed in thirteen steps for normal to 50 per cent of normal. It is also possible to disconnect one side of the compressor, operating only the other side as a single engine, thereby increasing the flexibility of the plant. A 30-ton unit is now being added. The water in this plant is taken from the city supply, filtered and turned into the tanks, producing excellent, clear ice. During the process of freezing the water is constantly agitated by means of air, which is supplied by a small blower operated by a 7½-hp motor. In addition there are two water pumps, one brine pump, an ice saw, two tilting tables, an ice elevator and two cranes, each driven by a three-phase, 25-cycle, 440-volt induction motor, the sizes ranging from 2 hp to 7½ hp. The following figures show the production and energy consumption monthly for the year 1910 in this plant:

ENERGY CONSUMPTION OF AN ELECTRICALLY OPERATED 100-TON ICE PLANT USING THE PLATE SYSTEM.

1910.	TONS OF ICE.		Maximum Horse-power.	Horse-power-Hours.	Maximum Horse-power per Ton.	Horse-power-Hours per Ton.
	Month.	Daily Average.				
January	.....	....	...	10,314	....	....
February	1,420	50.7	145	98,214	2.86	69.2
March	1,400	45.2	153	105,845	3.38	75.6
April	1,168	38.9	139	78,933	3.58	67.6
May	1,786	57.6	138	101,798	2.40	57.0
June	1,037	34.6	278	120,720	8.00	116.4
July	2,294	74.0	280	201,791	3.78	88.0
August	1,800	58.1	290	209,200	4.98	116.2
September	2,244	74.8	283	198,157	3.78	88.3
October	1,115	36.0	149	117,363	4.13	105.3
November	1,019	34.0	141	98,320	4.14	96.5
December	1,356	43.7	139	104,398	3.19	77.0
	16,639	....	...	1,445,053	....	86.8

Considerable variation in results from month to month is shown in this table. This illustrates the necessity of a division of compressor units as previously suggested, and, indeed, this improvement is being arranged in this plant. It will be noted that the total annual production is 16,639 tons of ice, with an energy consumption of 1,445,053 hp-hours, equivalent to 86.8 hp-hours per ton of ice on the average during the year.

Mr. Smith also described a 100-ton can-system ice plant electrically operated and supplied with energy by the central-station company in Buffalo. In the can system the water is first distilled or evaporated, and in doing so it is customary to raise the water to high-pressure steam, using this steam for power purposes, and thereafter condensing it for ice after taking out the engine oils, dirt, etc. As the condensed steam from the plant machinery is never sufficient to supply all the water needed for ice, a considerable amount of live steam is also used. It would be considerably more expensive to operate a can-system plant by purchased electric energy and evaporate the water by the usual boiler method than by the operation of a steam plant where the necessary power is obtained as a by-product, the exhaust steam being used for making ice. To overcome this excessive cost when using purchased energy, supplementary distilling apparatus is used in connection with a comparatively small boiler equipment, so that for a given amount of fuel a considerably greater amount of distillate is obtained than by the usual boiler evaporation.



Engine-Room of 100-Ton Can-System Ice Plant Electrically Operated.

The boiler-room equipment of this can-system plant consists of two 85-hp horizontal tubular boilers with mechanical stokers.

The illustration shows the engine-room of this plant, where two vertical ammonia compressors are each belt-driven by a 175-hp, 500-r.p.m., three-phase, 25-cycle, 2200-volt variable-speed induction motor. By means of the speed control of these motors the compressors can be operated at thirteen different speeds continuously; that is, from 72 r.p.m. to 11 r.p.m.

The controlling apparatus for this plant is arranged around the corner, where the primary incoming line panel is equipped with disconnecting switches and an automatic oil switch. From this panel the conductors are carried first to individual motor panels and thence to the motors. The resistance control, with its resistance, is connected through a drum controller to the rotor of the induction motor.

The efficiency of this type of motor is low at reduced speed, as the total energy input remains nearly constant for all speeds. It does, however, provide a flexibility of speed control practically equivalent to that of the steam-operated compressor, which is an essential item. During the four winter months only one compressor unit is operated. Varying conditions of operation indicate that the engine-room design of electrically driven ice plants should be given careful consideration, so that the compressor units may be so proportioned that the compressors can be operated singly or together at or near full rating, to suit the varying conditions of plant output throughout the year. This will permit the motors to be operated at or near their normal full speed, which is desirable. Of course, the engine-room design can be carried to such a degree of refinement that the first cost will overbalance the operating efficiencies. This must be guarded against.

In addition to the motor-driven ammonia compressors this

can-system plant is equipped with two 20-kw, 2200-440-volt transformers supplying energy to motors driving four brine agitators, a condenser pump, a pumping-out machine, a soft-water pump, a water-softener mixer and two cranes.

The following table gives operating data in relation to this electrically operated 100-ton ice plant using the can system:

ENERGY CONSUMPTION OF AN ELECTRICALLY OPERATED 100-TON ICE PLANT USING THE CAN SYSTEM.

1910.	TONS OF ICE.		Maximum Horse-power.	Horse-power-Hours.	Maximum Horse-power per Ton.	Horse-power-Hours per Ton.
	Month.	Daily Average				
January	1,768	57.0	123	87,070	2.16	49.24
February	1,549	55.3	137	79,450	2.48	51.29
March	1,903	61.4	221	93,760	3.60	49.27
April	2,732	91.1	232	164,558	2.55	60.23
May	2,651	85.5	257	165,488	3.01	62.42
June	3,024	100.8	300	188,666	2.98	62.39
July	3,442	111.0	314	219,265	2.83	63.70
August	3,503	113.0	300	208,123	2.65	59.41
September	3,514	117.1	291	209,027	2.49	59.48
October	3,379	109.0	283	185,177	2.60	54.80
November	982	32.7	137	88,070	4.19	89.68
December	1,853	59.8	129	93,914	2.16	50.68
	30,300	....	...	1,772,568	....	58.50

From these figures it will be seen that the total annual production is 30,300 tons of ice with an energy consumption of 1,772,568 hp-hours, equivalent to 58.5 hp-hours per ton of ice average for the year, with a maximum of 63.7 in July and a minimum of 49.24 in January (excluding November from consideration).

A comparison of the cost of producing 100 tons of ice in twenty-four hours by a steam-operated plant, based on a boiler evaporation of 8:1 and a coal cost of $2.50 a ton delivered, with the daily evaporation of 250,000 lb. of water, demonstrates that electricity can be applied successfully to commercial plants, especially on a large scale. The author pointed out that the question of relative cost of production between a plant operated by purchased electric energy and one run by steam rests entirely with the rate at which electric energy is obtainable. In Buffalo, of course, where electric energy obtained from the great water-power plants at Niagara Falls is distributed, the rates are low.

Electricity applied to ice plants offers the same advantages over steam as in other industrial plants. There is no question as to the quality and purity of the product, whereas in steam plants there is always the uncertainty of contamination from engine oils, grease, dirt, etc. The operating cost of the electric plant should be compared rightfully with that of a steam plant which will give the same guarantee of purity of production. Again, with the application of electricity to ice making and the elimination of coal, all the troubles and annoyances incident to the use of coal, such as provision for storage space, handling facilities, etc., are done away with. These all have their influence on plant location. This question of possible plant location is important, as in the future in large cities it is probable that a number of comparatively small ice-making plants will be located each with respect to the territory to be served, as opposed to large-sized producing plants with distributing stations.

Mr. Smith remarked in relation to the plant using the plate system that there had been some troubles in operating the plant owing to conditions encountered and that the results obtained would be better under proper conditions. He also said that this class of business—that is, commercial ice making by central-station energy—is most desirable from a central-station viewpoint. On the basis of the monthly maximum demand, the load-factor of the plants described ranged from 86 per cent to 99.7 per cent, with an average of 89.3 per cent. Considering the load-factor for the whole year, however, the average load-factor was 65 per cent.

Discussion.

Mr. G. T. Seely presided at the meeting, and in opening the discussion remarked that in Chicago to utilize the central-station energy it would be necessary, apparently, to make raw-water ice, although the people have been educated to the use of distilled-water ice for the artificial product, and it seems doubtful whether electricity can be supplied from a steam-driven central station at a price enabling it to be used to make ice from distilled water.

Mr. E. W. Lloyd, general contract agent of the Commonwealth Edison Company, emphasized the fact that it takes less than 50 kw-hours to make a ton of ice. The central stations are looking for summer load, and the ice plants supply it. In Chicago two ice manufacturers are about to start up, with plants in which electrical energy will be used to manufacture raw-water ice. They seem to have some secret process by which clear raw-water ice may be produced. Mr. Lloyd believes that the value of distilled-water ice has been greatly exaggerated and that much ice is sold under this name which is really raw-water ice. He thinks the latter is the coming thing in the artificial-ice business and that it will prove satisfactory to the public. As to the price of electricity in making ice, the speaker thinks that ice can be made at a handsome profit to the manufacturer with electricity supplied from steam-driven central stations. Ice plants are ideal for the new off-peak rate of the local electric-service company. This rate provides for an annual charge of $15 per kw-year, plus possibly 0.4 cent per kw-hour for energy under the conditions that obtain in ice making. This particular rate is made with the provision that the consumer refrain from using electricity in the months of December, January and February between the hours of 4 p. m. and 8 p. m.

Mr. W. B. Jackson commented on the fact that the load-factor in the Buffalo plants was reduced from 89 per cent on the monthly basis to 65 per cent when figured annually. This was owing to the heavy demand in summer months and was a very good fault.

Mr. Smith said that there are two raw-ice methods. One is called the cell system, in which the water is frozen in tanks without tops or bottoms. This system is arranged so that the impurities rise to the top of the cake of ice in the can and are cut off. There is also the so-called "center-freeze" system, which is a straight-can system with separate means for freezing a core in the center of the can, by this means removing the impurities at the center. Manufacturers of raw-ice systems should have the co-operation of central-station men. The field is very large and important.

Mr. H. E. Niesz, general manager of the Cosmopolitan Electric Company, after remarking on the desirability of ice-making load for central stations, said that the difficulty seems to relate to the character of the product. The ice makers say that the public wants distilled-water ice, and therefore they install steam-driven compressors, because they have to have distilled water. If the public can be educated to use raw-water ice it will not be difficult to get the makers to purchase electrical energy at commercial rates from steam-driven central stations. Or, as an alternative, if a way could be devised to distil water very cheaply the manufacturers could afford to do this and still buy electricity. The situation appears to be that a cheap method of distilling water must be devised, or the public must be educated to use raw-water ice.

Mr. Fay Woodmansee said that the central-station men might bend their energies to operating small refrigerating plants on customers' premises. He also suggested that the central station might sell water from steam-turbine condensers to ice companies.

Mr. Smith thought that in the long run the business of the ice manufacturers would be more valuable to the central station than that of the small consumers.

Mr. W. L. Abbott, chief operating engineer Commonwealth

Edison Company, told of the practical difficulties in the way of utilizing water from steam-turbine condensers for making ice. The first is the lack of space for the apparatus used in the making, handling and storage of the ice; second, the process would take from the steam turbine one of its great advantages, which is returning pure distilled water for use in the boilers. Mr. Abbott referred to the economical size of ice-making plants. These plants should be of such a size that the product can find a market within easy teaming distance—say, a radius of two miles. This means about a 150-ton plant, and this consideration is in favor of the use of electrical energy.

Prof. P. B. Woodworth, of Lewis Institute, corroborated Mr. Lloyd in saying that a great deal of alleged distilled-water ice is really raw-water ice. Electrical men should assist in the education campaign for the use of raw-water ice. Lewis Institute will be glad to make analyses of ice to determine the number of bacteria or other harmful contents.

Other speakers made the point that what the people want is clear ice; they do not care particularly whether it is made from distilled or raw water. There is no particular prejudice in favor of distilled-water ice, but the appearance of the ice is very important. Mr. George H. Jones, Commonwealth Edison Company, said one of the best hotels in Chicago makes all of its ice from raw water. Mr. Smith remarked that the ice used in hotels, even high-class hotels, is often not of a character that private consumers would accept.

Mr. F. F. Fowle asked why cold-storage warehouses could not be economically taken on as a central-station proposition. He also spoke of the benefits to be derived by combinations of public utilities in small cities. For instance, water-works pumping is almost on a parallel with ice making as a summer load. The public utility company in a small city may well distribute electricity, gas, water and ice. Messrs. Paul P. Bird, J. H. Delany and George H. Lukes also spoke briefly.

Valuation of Consolidated Public-Service Corporations.

The interesting resolution of Alderman Pringle introduced in the Chicago City Council on March 6 (*Electrical World*, March 23, 1911, page 716), intended to prevent duplication in valuation, for rate computation, where public-service corporations are combined, has not been adopted by the aldermen. At the last meeting of the retiring City Council, on April 17, Alderman Pringle moved the adoption of the resolution (reported favorably by the committee on gas, oil and electric light), but after debate consideration of the report was deferred. According to the resolution, if adopted, it will be "the sense of this Council that in all consolidations and combinations of public-service corporations in this city the construction account of the purchasing company shall be charged only with the cost of the property actually used by and useful to the purchasing company in the furnishing of the service involved."

Stealing Electricity by Cable Tapping.

In its vigorous campaign against electricity thieves under the Missouri law of 1909 the Union Electric Light & Power Company of St Louis has encountered some ingenious expedients to obtain electrical energy without paying for it. Often a "jumper" was used to by-pass the meter, but the proprietor of a rooming house on Seventh Street adopted a different method. In this case service had been given in proper form to electric fans during the summer. At the end of the heated term the proprietor informed the Union company that he would have no further need of electricity and it was turned off, but the secret service men of the company, passing the place some time later, observed that the electric lamps were on in broad daylight. Knowing that the central station had no agreement with the proprietor to furnish electricity, they went to police headquarters and got a detective to accompany them to the rooming house. The detective asked the proprietor what kind of light he was using and was told "just gas and coal-oil lamps." The detective then presented the electrical men and stated that they wanted to go upstairs and trace some wires. As they proceeded the wife of the proprietor attempted to block the way. The detective, however, opened a door in spite of her and disclosed the electric lamps in use. The proprietor had tapped the cable after the removal of the meter and was able to feed incandescent lamps all over the house without cost to himself. In this case the defense was that the proprietor had no knowledge of electric lamps in the rooms upstairs. Judge Calvin N. Miller took the view that the case clearly came within the meaning of the new statute. He imposed a fine of $100. This is considered one of the most important cases made under the law.

Amended Public Utility Law of New Jersey.

The new public utilities law passed by the New Jersey Legislature at its closing session went into effect on May 1 and makes changes of great importance in the policy of that State respecting public-service corporations. It gives the commission the rate-making power and the right to make appraisals.

The present board is to constitute the commission until the expiration of the term of office of each commissioner, when a successor is to be appointed for six years in each case. The commissioners are not to be under thirty years of age and may be removed by the Governor for neglect of duty or misconduct in office. They are to have salaries of $7,500 annually, whereas the old law provided for salaries of $6,000. No commissioner or employee shall have any connection with or hold any securities in any public utility operating within the State, or hold any other position of profit or trust under the government of the State or of the United States. The total expenses, including salaries, shall not exceed $100,000 per annum. The previous law limited the annual expenditure to $50,000.

The board shall have general supervision and regulation of all public utilities. Public utility is defined to include substantially every plant or equipment for public use under privileges granted by the State or any political subdivision thereof. The board is given power to investigate, upon its own initiative or upon complaint in writing, any matter concerning any public utility. The clause regarding valuation gives the board power to appraise from time to time the property of any public utility whenever in the judgment of the board it shall be necessary for the purpose of carrying out any of the provisions of the act. The board has power, after hearing upon notice by order in writing, to fix just and reasonable rates whenever it shall determine existing rates to be unjust, unreasonable, insufficient or unjustly discriminatory or preferential. Every public utility shall be required to file complete schedules of every classification and of every rate. Power is given to the board to fix just and reasonable standards and measurements. The board shall have power to fix adequate and serviceable standards for the measurement of quantity, quality or other conditions pertaining to the product or service rendered, and to prescribe reasonable regulations for the examination and tests of product or service. It also has power to establish reasonable rules and standards to secure the accuracy of meters and appliances for measurements and to provide for their examination and test.

The board has power by its agents to enter upon any premises occupied by a public utility for the purpose of making examinations and tests and to set up on such premises any apparatus necessary therefor. It may fix the fees to be paid by any consumer for examination or test. The fee shall be repaid to the consumer if the appliance is found defective or inaccurate to the disadvantage of the consumer, and in that event shall be paid by the public utility.

Full power is given to the board to require safe, adequate and proper service and the maintenance of property and equipment in condition to enable such service to be furnished. Any rea-

sonable extension of existing facilities may be required where in the judgment of the board it will furnish sufficient business to justify construction and maintenance, provided that the financial condition of the public utility reasonably warrants the original expenditure required.

A section of the law relating to accounting gives power to the board to require every utility to keep its records and accounts so as to afford intelligent understanding of the conduct of its business, and to that end to require every utility of the same class to adopt a uniform system. Public utilities may be required to furnish annually detailed reports of finances and operations in such form as may be prescribed. A definite provision for a depreciation account states that whenever in the judgment of the board it may reasonably be required every public utility may be directed to carry a proper and adequate depreciation account, in accordance with such rules as may be prescribed by the board. The board shall ascertain and after hearing fix by order proper and adequate rates of depreciation of the property of each public utility, and these rates shall be sufficient to provide the amount required, over and above the expense of maintenance, to keep such property in a state of efficiency corresponding to the progress of the industry. Every public utility shall conform its depreciation accounts to the rates so ascertained, and shall set aside the funds so stipulated out of earnings and carry them in a depreciation account. The income from investments in this fund shall likewise be carried in the account. The fund shall not be expended otherwise than for depreciations, improvements, new constructions, extensions or additions.

Notice of accidents may be required and the board may make such investigation and order with respect thereto as in its judgment may be just and reasonable.

When any public utility shall increase existing rates or change classification the board shall have power to determine whether the change is just and reasonable. The burden of proof shall be upon the public utility. Pending determination the change may be suspended for a period not exceeding three months. It shall, furthermore, be the duty of the board to approve any change when satisfied of its justice and reasonableness.

No public utility may make any unjust or unreasonable, unjustly discriminatory or unduly preferential rate, or adopt any unjust or unreasonable classification. No utility shall adopt or maintain any price or measurement which shall be unjust, unreasonable, unduly preferential, arbitrarily discriminatory or otherwise in violation of the law, or provide or maintain any service that is unsafe or inadequate, or withhold any service which it can reasonably be demanded to furnish when ordered by the board.

Securities payable in more than one year from the date shall not be issued until authority shall have been obtained first from the board. The board shall approve any such issue maturing in more than one year from date when it is satisfied that the issue is in accordance with law, and the purpose of the issue is approved by the board. The capitalization of any franchise to be a corporation is expressly forbidden. No utility shall capitalize any franchise in excess of the amount, exclusive of any tax or annual charge actually paid to the State or any political subdivision thereof, as a consideration of the franchise, or capitalize any contract for consolidation, merger or lease, or issue securities against any contract of this nature. These provisions shall not prevent the issue of securities, subject to the approval of the board, by any lawfully merged or consolidated public utilities not in violation of the law.

Discrimination, gratuity or free service to any local, municipal or county official is hereafter forbidden. Without the approval of the board no utility shall dispose of its property, franchises, privileges or rights, or merge either in whole or part with any other public utility. No public utility shall make upon its books any transfer of stock of any other public utility unless authorized by the board.

One unusual provision gives the board power to require every public utility to file a statement, verified by oath, giving the authority, powers and duties of every officer, director or head of department in such form as to disclose the source and origin of each administrative act or other action of the corporation.

No privilege or franchise hereafter granted by any political subdivision of the State shall be valid until approved by the board. When, after hearing, the board determines that the privilege is necessary and proper for the public convenience and to serve the public interests properly, the board shall have power to impose conditions as to construction, equipment, maintenance, service or operation. Every municipality operating any public-utility service shall keep the accounts thereof in the manner prescribed for the accounts of similar public utilities. Witnesses subpœnaed at the instance of parties other than the board shall not be entitled to compensation from the State for attendance or travel at the rates otherwise provided of $1 for each day's attendance and 3 cents for every mile of travel unless the board shall certify that their testimony was material to the matter investigated. If the person subpœnaed fails to obey the command without reasonable cause, or refuses without lawful cause to be examined, or produce a book or paper when ordered to do so by the board, application may be made by the board to the Supreme Court for an order directing such person to show cause why he should not comply. The court shall examine such person and order compliance. Any failure to obey this order may be punished by the court as a contempt. No person shall be excused from testifying or producing any record when ordered so to do by the board upon the ground that it would incriminate him, but no person shall be prosecuted for any act concerning which he shall have testified or produced documentary evidence under oath, except that no person so testifying shall be exempt from prosecution for any perjury committed in the testimony.

In default of compliance with any order the person or public utility affected shall be subject to a penalty of $100 per day for every day of continuance of the default. Any person who shall knowingly and wilfully do or join with others in causing any corporation to do or solicit, or knowingly and wilfully instruct any officer, agent or employee of any corporation to do, any act forbidden by the law shall be guilty of a misdemeanor. Similarly the neglect to do anything required by the law shall constitute a misdemeanor. Any public utility which shall perform any forbidden act or neglect to perform any required act shall be guilty of a misdemeanor.

Any order made by the board may be reviewed by certiorari or by petition to the Supreme Court of the State within thirty days. The Supreme Court shall have jurisdiction to set any order aside when it clearly appears that there is no evidence to support the order, or that the board is without jurisdiction. The allowance of a writ of certiorari or the institution of any proceedings for the review of an order shall not stay the order, unless the Supreme Court shall so direct.

Massachusetts Legislative News.

Attorney-General James M. Swift has sent in a report to the Massachusetts House of Representatives declaring that, in his opinion, a bill requiring street-railway companies to carry free on their passenger cars United States letter carriers in uniform would be unconstitutional. The opinion points out that in 1901 Attorney-General Knowlton advised the Legislature that a bill requiring the transportation of letter carriers at a rate less than that collected for ordinary passengers was unconstitutional so far as the Boston Elevated Railway Company was concerned, and the present opinion holds that a general statute would be unconstitutional as applied to street-railway companies as a whole. The right of the Legislature to fix fares is undoubted, but it cannot under pretence of regulating fares and freights require a street-railway company to carry persons or property without reward. The rate fixed must be reasonable, and a requirement that any class of persons be carried free is not a reasonable or proper exercise of the distinctly rate-making power. The opinion also holds that such a course cannot be justified as an exercise of the usual police powers of the Legis-

lature on the ground of promoting the safety, health or proper convenience of the phblic.

In a special message to the Senate and House of Representatives on April 26 Gov. Eugene N. Foss severely criticised the high cost of electric energy in the isolated plant serving the State House, in connection with an investigation of the cost of the general service of the capitol. At the instigation of the Governor Messrs. C. L. Harpham and H. L. Coe investigated the cost of administration in connection with the State House, and the latter found that the cost of energy per hp-year at the State House is $220 and that for average service in business concerns this cost is from $35 to $40 per hp-year. The Governor called attention to the fact that the investigation was conducted by an experienced engineer, and says further: "Under exceptional circumstances such privately supplied power, running twenty-four hours per day, might reach $85. Mr. Coe finds that this inefficiency extends even to the fire-room, where the average coal shoveled per man per eight-hour shift is 2.5 tons against at least 5 tons shoveled in good practice. * * * I believe that the sergeant-at-arms is not responsible for these excessive costs. The trouble is with the grossly unbusinesslike methods under which these different lines of work are intrusted to him." It is probable that the Governor's message will arouse still greater interest in the question of purchasing electricity from the Boston Edison company, which has been under protracted consideration in capitol circles during the present session.

Maryland Commission News.

The Maryland Public Service Commission has received a petition from the Susquehanna Transmission Company, of Maryland, requesting authority to issue $1,031,000 first-mortgage bonds at 5 per cent in order to meet the terms of an agreement entered into with the Pennsylvania Water & Power Company whereby the latter corporation agreed to supply the funds for the construction of the transmission company's lines, in return for which it was to receive bonds at $1,000 par value for $900, to the amount of the loans. The transmission company set forth in the petition that it had already been provided with funds by the Pennsylvania Water & Power Company to the amount of $928,237.02, with which it had practically completed the construction of its physical properties and now desires to deliver the bonds promised to its creditor.

The Hagerstown & Clear Spring Railway Company has petitioned the commission for the privilege of exercising its franchise. It is understood that construction work will begin on the road, and the request filed asks for the further privilege of issuing bonds and stock from the sale of which the money to carry on the work will be derived.

Mr. Joseph H. Jacobs has appealed to the commission to ascertain whether or not 10 cents can be charged for sending a telephone message through a hotel exchange when local messages are supposed to be handled at 5 cents each. Mr. Jacobs' complaint is directed against the Chesapeake & Potomac Telephone Company. He asserts that on April 19 he made a local call from the Hotel Kernan, for which he was forced to pay 10 cents, the message having passed through the exchange in the hostelry mentioned. He wants to know if the charge is legal. The complaint of Mr. Jacobs raises a point that is of considerable public interest. Several hotels charge 10 cents for putting local calls through their exchanges. It has generally been supposed that the extra 5 cents was added on by the hotels and that the telephone company received no benefit therefrom. Mr. Jacobs' complaint will determine this.

The Chesapeake & Potomac Telephone Company has filed a petition with the commission asking that an order be passed authorizing it to purchase the capital stock of the Western Maryland Telephone Company, of Allegany County. The entire capital stock of the Western Maryland Company amounts to $100,000, and the petition asserts that after negotiations looking to the mutual advantage of both telephone companies and the improvement of the telephone service to the public the Chesapeake & Potomac Company obtained a written option, dated April 11, 1911, for the purchase of all of the capital stock of the Western Maryland Company, which was signed by the voting trustees of the property. Under the terms of this option, which the commission is asked to approve, the Chesapeake & Potomac Telephone Company agrees to pay the holders of the Western Maryland Company's stock $40,000 in cash and $40,000 in the common stock of the American Telephone & Telegraph Company, being 400 shares at par value of $100 per share.

Ohio Commission News.

The committee on railroads and telegraphs of the Ohio Senate has reported out the public utilities bill. Because of numerous amendments it differs materially from the draft passed by the House of Representatives recently. Physical valuation as a basis for determining rates was stricken out and the market value of stocks, with proper consideration for surplus, depreciation and other charges, is to be used in its stead. The bill also gives the proposed commission the right to prevent competition by forbidding the exercise of a new franchise granted by municipal councils.

Street and interurban railways, water transportation, union depot, freight line and equipment, sleeping car and express companies are classified as railroads under the amended bill and as such will be amenable to the present railroad laws. In addition, the commission will have control over the issue of stock and bonds, and its authority will be otherwise extended to a certain extent.

All other utility companies, such as telephone, electric light, telegraph, etc., come under the head of utilities and will be subject to the new bill. However, many of the stringent requirements have been eliminated with regard to these and such additions as have been made do not impose serious burdens.

The requirement that physical connection be established between telephone companies has been omitted, but the provision for joint use of conduits, poles, subways and other equipment was allowed to stand, so long as the capacity is not fully required by the owners. The Langdon provision for the establishment of units of measurement of service was replaced by the general provision that the commission may fix the details of reports to be made to it and use its own discretion as to fixing standards of measurement.

The section relating to stock control remains as fixed by the Langdon amendment in the House, with the exception of giving companies the right to issue stock and bonds for the reorganization or readjustment of indebtedness and capitalization. In the case of receiverships companies are exempted from stock control up to the limit of the old indebtedness and the securities issued for new capital. The commission has the right under the revised bill to withhold all information from the public if it sees fit. The House bill limited the time for which such information could be withheld to six months.

The commission shall have the right to pass upon a rate contract made with city councils, except in the case of street railways, but the company must give bond to safeguard the consumer when rates are called in question. The company must continue to furnish service under a new ordinance when ordered to do so by the commission. But the old provision permitting a receivership in case of violation of such orders is omitted. Council may compel the construction of extensions, subject to the consent of property owners.

Although the bill does not take away the right of municipal councils to grant franchises, the commission may forbid the exercise of a grant if it deems that it is not a public necessity or convenience. In this way the commission may prevent competition, according to the friends of the House bill.

Under the rewritten section relating to consolidations, utility companies may take this step on consent of the commission, but

will not be allowed to increase rates or capitalization until so permitted by the commission. It permits one company to purchase the business and franchises of another or to lease or purchase stock control, the latter being forbidden in the House bill.

The provision limiting the ownership of stock of one corporation by another to 25 per cent was eliminated and orders of the commision may be enjoined and carried through all the courts. The original bill permitted a review of such orders by the Common Pleas Court, but legal proceedings could go no further.

As the vote for the bill in the House in its more rigid form was very large, there is some question as to its concurring in the changes reported by the Senate committee, but there is a well-grounded belief that it will go through the Senate without trouble. Some complaint has been made to the effect that the bill, as it now stands, is for the purpose of permitting the consolidation of telephone companies and that its friends expect no other decisive results from it. The state railroad commission is made the public utility commission by it.

Massachusetts Commission News.

The Massachusetts Railroad and the Boston Transit Commission, sitting as a joint board, sent a report to the Legislature on May 1 recommending the abandonment of the plans for building the so-called Riverbank subway in Boston and the construction of a double-track subway in the Back Bay from the intersection of Commonwealth Avenue and Beacon Street to the present Park Street station. The estimated cost of the Boylston Street subway, which would be about 2 miles long, is $4,700,000, or about $1,000,000 more than the Riverbank estimate. If the new subway is built, which appears probable, it will provide a rapid transit electric route from the business district of Boston to the Allston, Brighton, Waltham, Watertown and Newton suburban municipalities, and it will form a symmetrical addition to the group of radial high-speed trunk lines which are peculiarly efficient under the Boston conditions.

CURRENT NEWS AND NOTES.

Rate Ordinance in Toledo.—At its last regular meeting the city council of Toledo, Ohio, passed an ordinance fixing the rate for electric lighting at 8 cents per kw-hour. with a discount of one cent, if the bills are paid within ten days. The minimum charge is reduced from the present figure of $1 to 50 cents a month.

Overruling of Low Telephone Rates.—By making permanent an injunction to restrain the city of Louisville, Ky., from putting into effect telephone rates providing for a maximum charge for business service of $66 a year the Federal Court in that city has upheld the Cumberland Telephone & Telegraph Company in its long fight with the city. The existing rate for business instruments is $90 a year, and the court sustained the contention of the company that the proposed rate would be confiscatory.

Serious Gasoline Explosion in St. Louis.—By an explosion of the fumes of gasoline from a railroad oil-tank car in St. Louis on April 22 seven persons were killed and six severely injured. The car is said to have contained 4000 gal. of gasoline and was not provided with a vent, apparently. Gas accumulated under pressure and escaped when the cap of the tank was removed. A fire in an adjacent watchman's shanty is believed to have caused the explosion, and almost immediately everything inflammable near the car was aflame. Four of the dead were members of one family in a nearby cottage. The chief inspector of the Fire Prevention Bureau of St. Louis speaks of the handling of gasoline as a great menace to life and property and deplores the fact that no ordinance exists in that city to regulate the handling and storage of this dangerous commodity.

Delay in Making Illinois Public-Service-Commission Law.—Seven bills proposing public-service commissions in Illinois were introduced at the present session of the Legislature in Springfield, but none of them will be adopted at this session. Both the Senate and the House voted on April 28 to refer the subject of commission regulation of public utilities to a joint commission of Senators and Representatives to report to the next General Assembly or to a special session of the present one.

Denial of Reported Merger of Kentucky Telephone Company.—In an interview at Toledo, Ohio, Mr. Edward H. Cady, president of the Central Home Telephone Company of Louisville, stated that there is absolutely nothing in the report of a contemplated merger of the Independent telephone interests of Kentucky. He says that no negotiations are under way to that end and none are contemplated. Mr. Cady is in position to speak on this matter because of his connection with the Louisville Company.

Dissatisfaction of Chicago Aldermen with Hagenah Gas Report.—The elaborate investigation of the People's Gas Light & Coke Company, of Chicago, by Mr. William J. Hagenah, made for the Chicago City Council, has not been received with enthusiasm by the present Council committee on gas, oil and electric light. Politics is mixed up in the matter, the political complexion of the Council, and hence of the committee, having changed as the result of the spring election. A second expert may be selected to make a new report. Mr. Hagenah made an extended investigation and recommended a net rate of 77 cents. The new city administration has declared for 70-cent gas. The present rate is 85 cents.

Denial of Lamp Manufacturers of Allegations in Suit.—Answers have recently been filed to the suit brought in the United States Court at Cleveland, Ohio, by the following: Capital Electric Company, Denver, Col.; Franklin Electric Company, Hartford, Conn., and the Gilmore Electric Company, Boston. Each of them denies the charges in the petition and states that it is not guilty of disobeying the anti-trust laws. Rumors have been afloat in Cleveland to the effect that the government would be satisfied with an agreement offered by the companies involved in the suit whereby certain features deemed illegal by the Attorney-General's office will be eliminated. District Attorney Day of Cleveland, in an interview with a local paper, refused to discuss the matter in any way.

Meeting of Electric Vehicle Club.—The regular weekly electric vehicle luncheon given by the Boston Edison Company to further the development of the electric truck and pleasure automobile was held at the company's offices on April 26. About twenty representatives of electric vehicle manufacturers and allied interests were present and an association was formed under the name "Electric Vehicle Club," Mr. L. D. Gibbs, of the Boston Edison Company, being elected permanent secretary. A chairman will be chosen at each meeting. Various committee reports were received, including one upon the location of signs and their wording, and a report upon organization. An investigation is to be made of the rates for charging vehicle batteries in the eastern part of Massachusetts, although it is believed that the regular Edison rates work out fully as well as the special tariffs that have been and are being charged for the service. A committee on charging stations is to investigate conditions within 50 miles of Boston, making a list of such points, which will be printed for general distribution to vehicle users and other interested parties.

Fireproofing Electric-Car Wiring.—The Denver City Tramway Company, upon the recommendation of the Rocky Mountain Fire Underwriters' Association, is improving its car wiring by the use of flame-proof braids for fireproofing the car body in the neighborhood of cables and the like.

Conduit Wiring in Telephone Buildings.—On the recommendation of the Rocky Mountain Fire Underwriters' Association the Colorado Telephone Company is beginning the rewiring in conduit of all of its buildings in Colorado and New Mexico for all lighting and motor-service circuits.

Joint Engineering Meeting in Chicago.—The next joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers will be held at the rooms of the former on May 24. Mr. S. G. McMeen will read a paper on telephone work in San Francisco and vicinity.

Patents.—At a meeting of the American Society of Mechanical Engineers to be held in New York on May 9 the general subject for discussion will be patents. Among those who will discuss the subject are Messrs. E. W. Marshall, D. Howard Heywood and Edwin J. Prindle. The purpose of the meeting is to outline to the engineer and manufacturer the fundamental principles of the patent law.

Morbid Relic Hunters.—A transformer and distributing pole at one of the principal street intersections of a Southern city which was utilized by a mob in a recent lynching has been so chopped and hacked by relic hunters as actually to weaken the structure, making it necessary for the central-station company to sheath the pole for a height of 10 ft. with heavy galvanized iron to prevent further mutilation and weakening.

Ozone and the Fly.—One of the interesting claims made to further the use of electric ozone-making machines is that the use of ozone in deodorizing the air is of distinct value in the campaign to abolish the common house fly on the score of health. It is pointed out that the fly usually seeks the place where offensive odors are present, apparently attracted by the odor, and as ozone is a deodorant the ozone machine helps to make conditions unfavorable to the flies.

Central-Station Conference at University of Illinois.—A recent central-station conference held under the auspices of the department of electrical engineering of the University of Illinois, at Urban, Ill., was attended by about forty plant managers. It was held to establish closer relations between central-station men and the electrical engineering department of the university. Papers on various subjects of interest to operating men were read by Dean W. F. M. Goss, Prof. Ernst J. Berg, Prof. J. M. Bryant and Mr. R. Y. Williams.

Electric Vehicles at Dallas, Tex.—In Dallas, Tex., there are now in service about sixty-five electric vehicles, all of which are pleasure cars. The Dallas Electric Light & Power Company is arranging to install an electric truck in its own service to demonstrate locally the utility of battery-driven commercial cars. The city already has one exclusive electric garage, but the majority of the vehicles are stabled in private garages. The net charge for vehicle energy is 4.5 cents per kw-hour, with a minimum of $2 per month.

Proposed Ornamental Lighting Around Chicago City Hall.—The combined County Building and City Hall in Chicago occupy a full city block. It has been proposed to install a scheme of ornamental electric lighting, with handsome posts, about this imposing building, and Holabird & Roche, the architects, have prepared plans and specifications for such an installation, which is estimated to cost about $12,000. If the full scheme is carried out it will be necessary for the city and county to co-operate, but the county commissioners seem in no hurry to take action on the suggestion. The matter now rests with the finance committee of the City Council so far as the city is concerned.

Ohio State University Student Inspection Trip.—About 100 students of the departments of mechanical and electrical engineering of the Ohio State University, accompanied by four instructors, spent three days in Chicago, two days in Milwaukee and one day in Gary, Ind., on an inspection trip covering the week ended April 29. The university issued a special forty-eight-page bulletin descriptive of the establishments visited at each place. Each student was provided with a copy of this bulletin interleaved for use in note-taking. The inspection trip is part of the student's regular university work, and he is required to submit a written report, together with his original notes taken during the trip.

One Method of Encouraging the Use of Electricity.—Although at the same time tacitly admitting the shortcomings of municipal ownership, the progressive manager of a town plant in a conservative community wields a gentle club over his tardy prospective new customers by explaining to them that if they fail to use electricity to replace their oil lamps the tax rate will be raised to meet the deficit in the plant's operation, so that they will have to pay anyhow. Therefore, they might as well, he points out, benefit from the use of electricity. This kind of argument usually starts a stampede for service, and kerosene standpatters that could be reached in almost no other way soon become delighted electrical customers.

Block Lighting in Chicago.—Chicago has several so-called "block-lighting" electric plants doing a central-station business within an area included in a city block. Perhaps the largest of these is the Gunther Electric Company, which does business in the block bounded by West Adams Street, South State Street, Quincy Street and South Dearborn Street. On Dec. 31, 1909, according to the report of the city electrician this company was supplying electrical energy to 12,000 incandescent lamps, 200 arc lamps and motors having a rating of 380 hp. Recently the Chicago City Council passed an ordinance giving authority to this company to maintain and operate a vault under a portion of the surface of the alley in the block named. The ordinance was passed March 27, 1911, and will expire Dec. 17, 1919. During the life of the ordinance the company is to pay $183.48 a year for the privilege conferred. The vault in question is now constructed, and it is provided that the annual compensation shall date from Dec. 18, 1909.

New York Electrical Society Meeting.—At a meeting of the New York Electrical Society held on April 28 Mr. Frank A. Patterson described in outline the electrical equipment of the New York Public Library, which was designed in 1897. In the basement is located a generating station consisting of two 500-kw and two 200-kw, 250-volt direct-current generators for supplying energy to 700 hp in motors and about 20,000 carbon-filament incandescent lamps. All of the apparatus around the building is electrically driven. The building is equipped with a complete printery and bindery, every motion of which is operated by motors. The books are carried by electricity to their proper positions from the printery and bindery, after they have been repaired, likewise by electricity. The ventilators and book conveyers are all operated by motor. There is a complete fire-alarm system, with an automatic thermostatic fire alarm added to the manual alarm in the sections where the rare books and manuscripts are stored. As time is an essential element in a library, fine clocks, made synchronic electrically, have been set up wherever needed by the public and the attendants. There is also a fine electrical system of watchmen's clocks. The electric wiring is thoroughly fireproof, iron conduit being used throughout. A complete description of the wiring of the book stacks appeared in our issue dated Oct. 17, 1908.

Revenue from Electrical Inspection.—The Department of Electricity of the city of Chicago reports that the revenue received by the city from fees for electrical inspection in 1910 amounted to $131,798. The amount collected in 1906 was $64,845, showing a marked increase in four years.

Purchase Plan Abandoned in San Bernardino.—As a result of a report made by Mr. C. W. Koiner, chief engineer of the municipal electric light plant of Pasadena, the City Council of San Bernardino, Cal., has abandoned the idea of purchasing for municipal operation the local plant of the Lytle Creek Power Company. The price asked was $180,000, while the value fixed by the Koiner report was $98,886.

Proposed New York State Department of Electricity.—A bill has been introduced in the State Senate at Albany providing for the creation of a department of electricity for the State of New York. The measure aims at the consolidation of the jurisdiction pertaining to electrical supervision now in the hands of local authorities. It provides for a state commissioner of electricity at a salary of $5,000 a year, and carries an appropriation of $25,000.

Reduction of Rates in Ontario, Cal.—The City Council of Ontario, Cal., has instructed the city attorney to prepare an ordinance which will have the effect of reducing the rate for electrical energy from 13 cents to 11 cents a kw-hour. The monthly minimum of 90 cents will be unchanged. The Ontario Power Company asked, but unavailingly, that the present rate remain until Jan. 1, 1912, when it was promised that the reduction should be made.

Engineering Education.—The nineteenth annual meeting of the Society for the Promotion of Engineering Education will be held at Pittsburgh, Pa., on June 27, 28 and 29. The headquarters will be at the Carnegie Technical Schools. At the meeting special attention will be given to the reports of the committees on the teaching of mathematics to engineering students and entrance examinations for technical schools. The secretary of the society is Prof. H. H. Norris, Cornell University, Ithaca, N. Y.

Gas-Producer Experiments.—At the Experiment Station of the United States Bureau of Mines, Pittsburgh, Pa., several trial runs have been made with an experimental gas producer, using coke as fuel, with which limestone has been mixed in varying proportions, the purpose being to flux the ash and form a liquid slag, thus avoiding clinker and ash troubles and consequent shutdowns. Liquid slag has been readily made which runs freely from the producer. The high temperatures necessary are very efficient in the generation of gas.

Train Dispatching by Telephone.—According to a recently issued bulletin of the Interstate Commerce Commission, the use of the telephone in transmitting train orders continues to increase steadily. During the year 1910 there was an increase of 15,373 miles of railroad on which the telephone is used for this purpose. On Jan. 1, 1911, the telegraph was used for train dispatching on 175,211 miles of railroad in the United States and the telephone on 41,717 miles. The bulletin also shows that at the beginning of the year 71,969 miles of railroad in the United States were operated under the block-signal system, 17,711 miles of which were automatic.

Credit Where Credit Is Due.—In an article entitled "Modern Alternating-Current Coal Docks at Duluth, Minn.," in our first issue for April, certain of the statements relating to the extent of the coal-handling operations around the Duluth-Superior harbor were misleading in that to the former place was given whole credit for developments many of which should have been credited to the latter place. Of the whole number of coal docks around the harbor only one-third, and not the whole, are at Duluth, fourteen of the twenty-one coal docks being at Superior; moreover, the average amount of coal handled by a Superior dock is larger than that handled by a Duluth dock.

Reliability of Single-Phase Railway Service.—From reports of train operations in New York State during January, recently given out by the Public Service Commission, it appears that the New York, New Haven & Hartford made the best showing of all roads in the State, with 90 per cent of its trains on time. The report is especially interesting in view of the fact that the New Haven is extending its single-phase electrification to its Harlem division and another branch, and is reported as planning an extension to New Haven. It has been unofficially stated several times recently that the New York, New Haven & Hartford had practically no motive-power delays in handling the entire passenger traffic of its New York end by single-phase electric locomotives and multiple-unit trains, notwithstanding the necessity for changing from steam to electricity at Stamford.

Inviting Death as a Sign of Bravery.—The *Chicago Daily News* of April 10 tells the simple, pathetic story of the death of thirteen-year-old Stanley Ciesielski. "Early in the afternoon before the arc lamp at West Thirty-fifth Place and Gage Street was lighted Edward McMahon, thirteen years old, climbed a pole and hooked some bailing wire over the main feed wires leading to the lamp. After the current was turned on the boys dared each other to touch the wire. Stanley was the only one to accept the dare. Walking boldly to the wire he grasped it with both hands. The shock which he received threw him off his feet and a moment later his frightened playmates picked him up and carried him to his home. Dr. O. L. Mitchell, 3500 South Halstead Street, was called and pronounced him dead." The moral that parents and teachers should impress on children the danger of fooling with electric wires is obvious.

Independent Telephone Connection for Chicago.—By order of the court the Illinois Tunnel Company, controlling the automatic telephone system now nearing completion in Chicago, has been authorized to enter into contract with the Interstate Independent Telephone & Telegraph Company, joining the two systems for the interchange of business. The Interstate company is an Independent organization doing a telephone business in northern Illinois. Both companies are in the hands of receivers. The contract will give the automatic telephone people in Chicago direct connection with the large number of Independent telephone subscribers in Illinois and surrounding States. Heretofore the Independents have been unable to obtain connection with Chicago. The connections between the two systems will be made at the intersection of South Forty-sixth Avenue and West Twenty-second Street, on the western edge of the city, each of the companies having agreed to extend its lines to that point.

Extension of Street Lighting in Budapest.—In an article which was published in the *Electrical World* of Oct. 21, 1909, a description was given of the first trial street-lighting equipment installed by Mr. E. de Fodor as general manager of the Budapest General Electric Company. The results that have since that time been obtained show that with the flaming-arc lamp a street lighting can be obtained that is far ahead of all other kinds of artificial lighting in respect to even distribution and economy. The arc lamps in use there are of the 15-amp Alba type, and are connected three in series on a 110-volt circuit. The operating company has recently been authorized by the Municipal Council to extend the arc-lighting system in various important avenues. In addition to the 200 arc lamps already in use about 380 new lamps will be installed. It may be mentioned that last year the city bought out the gas company and has since been experimenting with "press gas," but the results have by no means proved as satisfactory as was anticipated.

GAS AND OIL-BURNING ICE-ELECTRIC PLANT AT MUSKOGEE.

Rapid Development of Electricity for Lighting, Motors, Etc., in a Twelve-Year-Old Oklahoma City.

MUSKOGEE, Okla., is one of the municipal phenomena of the Southwest. From a typical Indian village and frontier post fifteen years ago, the city increased 450 per cent in population between the census returns of 1900 and 1910, and to-day has a verified population of 28,000, with fine office buildings, hotels, banks, paved thoroughfares, street cars, residence sections, etc., that would be creditable to an older community of three times its size. A large factor in the growth of the city has, of course, been the local central-station company, which has kept step with the needs of the expanding municipality, in turn enjoying a development of its own business that has required the addition of one new generating unit after another to care for the increasing lighting and motor load.

Even more phenomenal than the increase in population of Muskogee has been, for example, the doubling of the local electric-lighting peak during the last year, increasing from 725 kw in 1910 to 1600 kw in 1911. The local central station also claims to have the greatest number of electric signs per capita—5.5 for each 1000 population—in any city in the country, all but twenty-nine of the 130 signs having been erected during the past twelve months. The day motor load has meanwhile increased to a gratifying degree, and a number of unusual installations are connected to the central-station company's lines. Characteristic of the Oklahoma country, the best is considered none too good for any purpose, consequently electricity receives many opportunities to demonstrate its utilities which might not be available in an older community.

The Muskogee Gas & Electric Company supplies alternating-current electrical service and also natural gas to consumers in the city, its local electrical generating station being one of the few plants in cities of over 25,000 in which ice manufacture is carried on in combination with the production of electricity. The central-station company also generates and supplies 550-volt direct-current energy for the local street-railway system. Part of its alternating-current output is transmitted at 6600 volts to Ft. Gibson, 10 miles distant, which is lighted from the

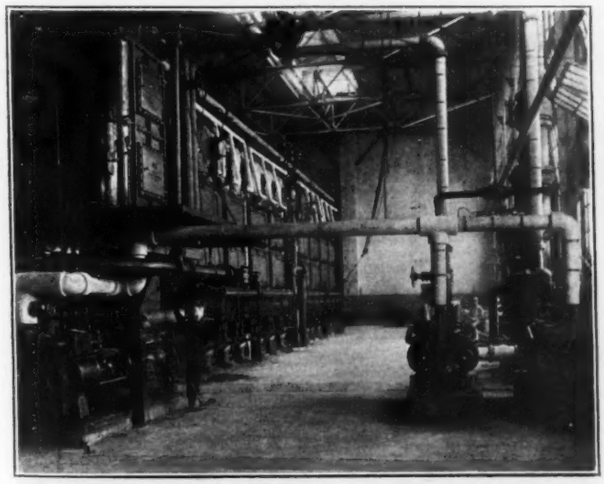


Fig. 1—Gas and Oil-Fired Boilers in Muskogee Generating Station.

Muskogee plant, the transmission line traversing a growing factory district on the way.

As might be expected from the rapid development of the city, the Muskogee steam-power plant has been largely a growth by the successive addition of machinery and buildings to keep pace with the demand for its output. The plant building, including the engine-rooms, boilers, ammonia compressor room and ice tanks, occupies a floor space, roughly, 110 ft. x 250 ft. The new engine-room building is a steel structure, with brick walls. The other buildings are of brick.

GAS AND OIL-FIRED BOILERS.

In the boiler-room, Fig. 1, natural gas from the Bartlesville field, 65 miles distant, is ordinarily employed as fuel, although for use in case of insufficient gas supply oil burners are provided beneath each boiler, fed from a large storage tank buried underground outside the plant. There are four 520-hp and two

Fig. 2—1500-kw Cross-Compound Engine-Driven Alternator in New Engine-Room.

250-hp Babcock & Wilcox boilers now installed, provision being made for additional settings. The 520-hp boilers have three fire-doors and the 250-hp unit two fire-doors. Each fire-door is arranged with five Kirkwood burners, a spiraled series of tubes in the mixing nozzle imparting a whirling motion to the mixture. An adjustable trapdoor on each burner enables the air supply to be regulated at will. Inside the setting, at a distance of about 6 ft. from the burners, the flames are broken up by a firebrick checkerwork structure. For the gas thus used under its steam boilers the Muskogee Gas & Electric Company would charge a similarly large user 5 cents per 1000 cu. ft. This gas has about 950 heat units per cubic foot. The natural pressure on some of the gas wells in the Bartlesville district reaches 800 lb. per square inch. The transmission pressure averages 200 lb., and at the city limits this is reduced and fed at 50-lb. pressure into a 12-in. main which encircles the city. High-pressure lines brought in from this main convey the gas to the power plant, where a final regulating valve holds the pressure on the 8-in. burner header at from 6 oz. to 8 oz. per square inch. The quantity of gas used is measured by a proportional-flow meter. All regulation of the header pressure on the burners is done by hand. The flue gases from the furnaces are led to a 200-ft. concrete stack, 14 ft. in diameter.

The emergency oil fuel for use in the special burners under the boilers is stored in a 30,000-gal. tank, ventilated by a flue and buried in concrete below the ground level just west of the boiler-room. A steam-driven pump delivers this oil at 30-lb. pressure to the burners, where it is mixed with steam issuing from a jet under about the same pressure obtained by reducing valves.

GENERATOR EQUIPMENT.

The new engine-room building is a steel-frame structure approximately 213 ft. x 61 ft. and 40 ft. high to the lower chords of the roof trusses. The latest and largest unit to be installed is a 2000-hp Allis-Chalmers cross-compound Corliss engine direct-connected to drive a 1500-kw General Electric 2300-volt, 60-cycle, three-phase alternator at 100 r.p.m. This engine, shown in Fig. 2, like all the other engines in the station, operates non-condensing. The engine-room has been designed for a duplicate of this unit, and the foundations are now being prepared for the new set, on account of the demand for its output.

Next to the 1500-kw generator unit is a 400-kw alternator direct-driven by an Allis-Chalmers cross-compound engine at 100 r.p.m. Two 300-kw Westinghouse 550-volt direct-curent railway generators, now belt-driven by Fulton engines, are to be

arranged for belted operation from General Electric 2300-volt synchronous motors, leaving the engines in place for future emergency service. The motor-driven railway generator sets will enable the principal railway load to be carried from the large alternators. In addition to these 300-kw railway machines

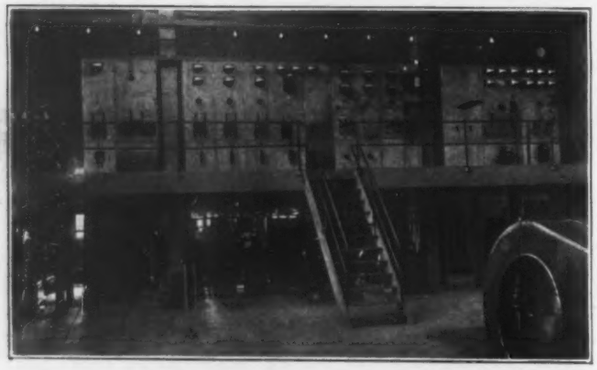


Fig. 3—Switchboard Gallery in Engine-Room.

there is a 450-kw, 550-volt General Electric generator belt-driven from a 600-hp Corliss engine in an areaway opening into the main engine-room. The excitation apparatus for the plant comprises one 50-kw and one 20-kw motor-driven set and a 50-kw generator driven by a vertical marine-type engine.

These machines and the outgoing feeder lines are controlled from a white-marble switchboard, Fig. 3, mounted on a gallery overlooking the engine-room floor. Beneath this platform are the three 100-kw, 2300/6600-volt transformers for the Ft. Gibson transmission, the three fifty-lamp and two 100-lamp constant-current transformers for the Muskogee street lighting and the automatic feeder regulators for the local single-phase commercial service. A distinct three-phase "power" or motor-service circuit is provided for all motor business, and no single-phase motor of over 1-hp rating is allowed on a lighting circuit where the third-phase wire is available. The engine-room is traversed by a 25-ton Whiting crane. The interior brickwork of both the engine-room and the boiler-room is finished in white enamel.

AMMONIA COMPRESSORS AND ICE PLANT

Installed in a separate room, 46 ft. x 62 ft., adjoining the main engine-room is the ice-making machinery, which comprises a 50-ton and a 15-ton steam-driven ammonia-compression plant, each complete with individual auxiliaries and freezing tank, and arranged for independent operation. The 50-ton ice machine comprises York Manufacturing Company twin vertical compressors driven by a horizontal tandem-compound steam engine. The 15-ton machine, made by the Vilter Manufacturing Company, is a horizontal ammonia compressor driven by a horizontal, simple, Corliss-valve engine.

Distilled water for the ice plant is stored in a 6-ft. x 12-ft. x 6-ft. tank after traversing six York charcoal filters. Brine for the cold-storage room is circulated by one of a duplicate set of 24-in. centrifugal pumps driven by 5-hp motors. A 10-hp motor drives an air compressor for operating an air hoist over the ice-can tanks. The 50-ton can tank has its brine circulated by two 5-hp motor-driven propeller agitators, while the 15-ton tank is agitated by a single 5-hp motor.

The combination of the ice equipment with the electrical plant, even in a station as large as that at Muskogee, enables the steam-production, boiler, fuel and labor expenses to be reduced and shared between the two departments, while the ice plant secures the supervision of an expert engineer. To a degree other real-estate, labor, office and overhead charges are also shared. The ice plant provides a steam load for the boilers during the slack summer season and its motor-driven auxiliaries utilize the generator output over long-hour periods when such electrical load is best spared. The resulting operation is thoroughly satisfactory from both the executive and operating standpoints. During about nine months of the year the small ice machine suffices to produce the 10 tons or 15 tons daily for which there is demand during the winter, while the remainder of the year the two machines are run, raising the plant to its 65-ton capacity.

MUSKOGEE'S WELCOME ARCH.

A feature of Muskogee's streets which attracts the attention of every main-line "Katy" railroad passenger, as well as of all visitors to the city, is the electric arch, illustrated in Fig. 4, which spans the main street near the Missouri, Kansas & Texas Railway depot. This double-faced sign is 94 ft. wide, 65 ft. high, and at its center clears the street by 42 ft. It contains 1500 lamps, the majority being 5-watt low-voltage tungstens. The letters in the word "Welcome" are 8 ft. high, and in the name "Muskogee" are 6 ft. At the heads of the columns bordering the arch huge torches or flambeaux, significant of the oil and gas-well fields on the edge of which the city stands, are simulated by colored lamps and flashers. This civic arch, which cost $3,100, was erected and presented to the city by the Muskogee Gas & Electric Company, the city paying only for the sign's operation every night from dusk to midnight. As an example of rapid construction it may be mentioned that this sign was up and burning twenty-three days after the order was placed with the Thomas Cusack Company, Chicago.

LAMP AND MOTOR SERVICE.

As already noted, the peak lighting load at Muskogee has increased more than 100 per cent during the last year, rising from 725 kw to 1600 kw in twelve months. The total connected load of the system, omitting, of course, the railway demand, is now 4200 kw in lamps and motors, divided among 3000 customers. A total of 436 hp in motors is now in use. In spite of the rapid growth of the load during the preceding year it is interesting to note also that as much business has already been contracted for during the first 100 days of 1911 as was closed during the entire twelve months of 1910.

The rates for lighting service at Muskogee range from 14 cents per kw-hour for the first 25 kw-hours down through 13 cents, 11 cents and 10 cents for each successive 25 kw-hours; then 6 cents, 5.5 cents and 4.5 cents for the next 100 kw-hour portions; 4 cents for the next 3600 kw-hours, and finally 3.25 cents, 2.5 cents, 2 cents, 1.75 cents, 1.5 cents and 1.25 cents respectively for each of the successive 1000 kw-hours. The minimum service charge is $1 for each meter installed.

The motor rate, applying to installations of 1 hp and over, begins at 5.5 cents per kw-hour for the first 500 kw-hours, diminishing to 3.25 cents for the next 2500 kw-hours, 2.72 cents for the next 3000, 2.5 cents for next 4000, 2.45 cents for

Fig. 4—Welcome Arch Presented to City of Muskogee by Muskogee Electric Company.

next 5000, 2.4 cents for next 5000, and 2.35 cents, 2.3 cents and 2.2 cents for the next successive 10,000 kw-hour portions successively. The minimum service charge is $1 per horse-power of connected rating.

Twenty-six electric vehicles are already in use on Mus-

kogee's streets, including the three trucks of the central-station company. The majority of the cars are stabled in private garages equipped with rectifier sets. The minimum monthly charge for such charging service is $7.50, exceeding which the rate begins at about 5 cents per kw-hour. The average car's consumption does not exceed the minimum, so that the income per vehicle is estimated at nearly $100 per year.

ELECTRIC SIGNS.

Muskogee has 130 electric signs, containing 15,000 sign lamps, two-thirds of which are 5-watt tungstens supplied from low-voltage transformers. With a ratio of more than five signs to each 1000 of population Muskogee claims to have more electric signs per capita than any other American city. These signs are operated on a flat rate, the company furnishing renewals and patrol service to turn them on at dusk and off at midnight. When the company supplies the sign also it charges 18 cents per 2-cp carbon lamp and 20 cents per 4-cp tungsten lamp per month; for panel signs the rate is 36 cents per 4-cp carbon and 50 cents per 8-cp carbon lamp. Providing the same service of energy, supply, renewals and patrolling for signs owned by the consumer the rates are 12 cents per 2-cp carbon lamp or 4-cp tungsten, and for panel signs 28 cents per 4-cp carbon lamp and 40 cents per 8-cp carbon lamp. Prompt payment entitles the above rates to 10 per cent discount.

A number of spectacular displays are in use in Muskogee, including many standard and unique designs. In Oklahoma some of the progressive banks, untrammeled by financial conservatism, keep their cashiers' windows open day and night. Fig. 5 illustrates the appropriate display adopted by the Muskogee Day and Night Bank, showing by a chaser flasher a coin dropping from the hand into the bank below.

A special "lighting district" has been formed in Muskogee for the purpose of erecting and maintaining a curb-post lighting installation on the streets of the business section. It is proposed to erect 400 three-lamp posts, each carrying one 60-watt and two 40-watt tungsten lamps. Unlike many similar installations, it is provided that no curb posts be installed at the curb corners of street intersections, the spacings being adjusted instead so that each post is about twice the width of the walk

Fig. 5—Novel Flasher Sign at Night Bank, Muskogee.

from the curb intersection. In this way an observer stationed at the center of the roadway intersections will see eight lamp-posts instead of four on the corners.

Among the motor customers of the Muskogee Gas & Electric Company are a model electrically driven bakery capable of producing 40,000 loaves of bread a day, several motor-driven refrigerating plants, motor-driven elevators, feed-grinders, printing presses, etc.

The Muskogee Gas & Electric Company is controlled and operated by H. M. Byllesby & Company, Chicago, Mr. H. C. Hoagland being general manager at Muskogee, and Mr. W. R. Emerson secretary-treasurer. Mr. H. I. Ward is superintendent of the electrical department, Mr. J. F. Owens is superintendent of the gas department, Mr. W. G. Miller is chief engineer and Mr. N. B. Hickox is manager of the new-business department.

ELECTRICAL ICE-MAKING IN THE NORTHERNMOST AMERICAN CITY.

As pointed out in these columns, several ice-making plants in cities have already found it profitable to purchase central-station energy for operating their ammonia compressors, under these conditions competing without difficulty with natural ice and with the product of fuel-burning ice

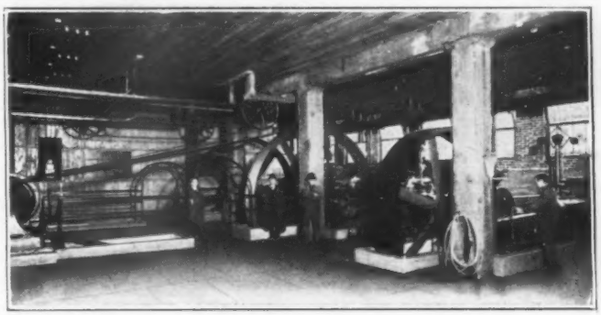


Fig. 1—Ammonia Compressor in Factory of Seattle Ice Company.

factories. From the central-station standpoint the presence of such a long-hour customer on its lines improves the company's load-factor, assuming off-peak duty for its generating equipment. On account of the twenty-four-hour character of the load the motor-driven ice factory usually also gains the advantage of a minimum rate for the energy it consumes, so that the arrangement is a mutually satisfactory one for both customer and company.

In general, as might be expected, cities in the South and Southwest have led in electrical ice-making. But as evidence that such ice manufacturer is not limited by climate or location it is significant that the northernmost large city in the United States, Seattle, Wash., in north latitude 48 deg., has

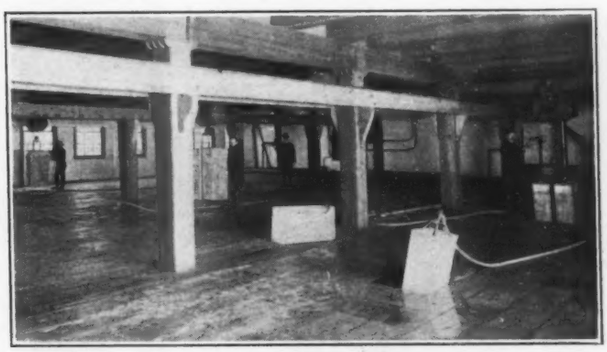


Fig. 2—Freezing Tanks Showing Method of Harvesting Ice by Electric Cranes.

had a 300-ton motor-driven refrigeration plant in successful operation for nearly two years, the energy for the compressors being purchased from the local central-station company.

The Seattle Ice Company occupies a four-story modern brick building, the compressor room containing five 60-ton ammonia machines. Four of these compressors are motor-driven, the

fifth being a steam-driven unit reserved for emergency use only. The motor-driven compressors are arranged in two pairs, each comprising a right-hand and left-hand crank unit, mounted on a common shaft, to which is keyed a 7-ton flywheel. Through a continuous-rope drive, with four-to-one speed reduction, and idler slack adjuster, each flywheel, double-compressor unit is connected to a 160-hp, 60-cycle, three-phase alternating-current motor running at 350 r.p.m. Details of this rope drive, including the pit construction, idler-adjuster arrangement and protected passageways beneath the strands are shown in the compressor-room illustration, Fig. 1. In the foreground is seen the auxiliary 60-ton compressor driven by a 16-in. x 36-in. Hamilton heavy-duty engine, which is held for standby service. The ammonia condensers, oil traps and liquid receivers are installed on the floor above the compressor apparatus.

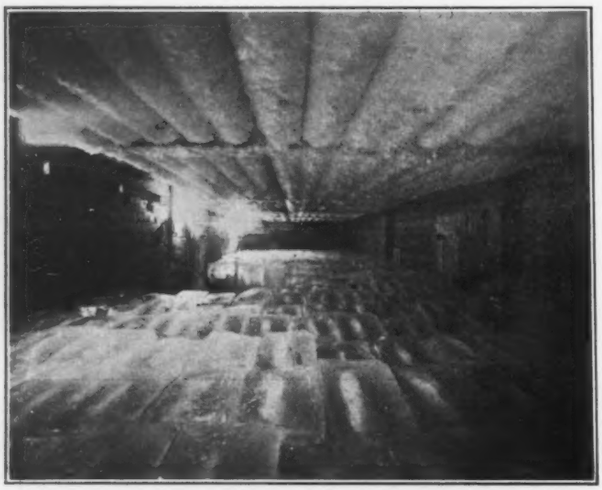


Fig. 3—Refrigerating Ice-Storage Room.

While some of the refrigeration produced in the plant is used to maintain at low temperature the large cold-storage space in the building, which has a capacity of 4000 tons, part of the liquefied ammonia is expanded in three 35-ton ice-making tanks employing the shell brine-cooler system of operation. In this cooler construction the usual ammonia-expansion pipes are replaced by a shell expansion tank, not unlike a five-tube boiler in form, the brine being forcibly circulated through the tubes, while the ammonia undergoes expansion inside the boiler-like vessel, extracting heat from the brine passing through the tubes. By this construction the usual racks of pipes are removed from between the cans in the brine tank, allowing closer spacing of the cans with consequent saving of space. The can structure is so arranged that the cans are free to rise slightly with the current produced in the brine by the circulation agitators. There are six of these bronze agitating propellers, two for each 35-ton tank, each pair being driven at 150 r.p.m. by a 5-hp motor. The shell-type brine cooling system is also declared to increase the tank efficiency of the freezing process, since the tank structure can be made more compact and can be better insulated. Less brine is consequently required to accomplish the same results.

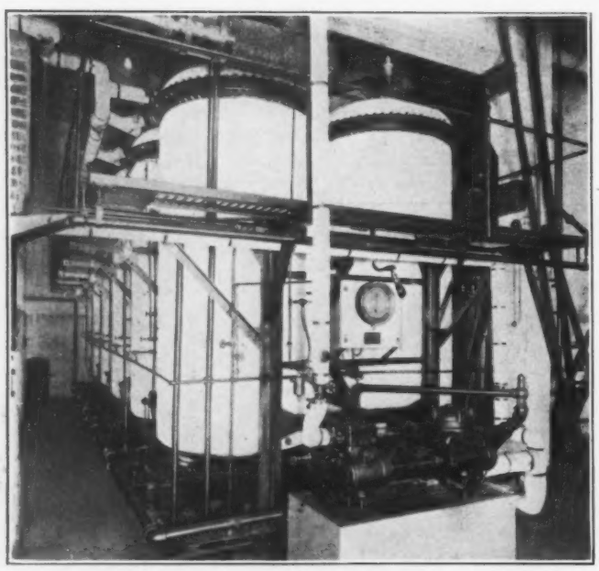


Fig. 4—Water-Purifying Apparatus.

As shown in the view of the tankroom, Fig. 2, the ice is harvested by electric crane hoists, which lift the cans out of the tanks and convey them to the three double automatic ice dumps, where the ice is thawed loose from the cans and discharged to the shipping platform or to the storage floor, shown in Fig. 3. Distilled water for ice-making is furnished by the distilling apparatus shown in Fig. 4.

The ammonia vapor is condensed, under pressure from the ammonia pumps, in seventeen sections of atmospheric-type single-pipe condenser, each section being 24 pipes in height and 20 ft. in length. The compressors, shell-type brine coolers, ice dumps, etc., of this motor-driven ice factory were furnished by the Triumph Ice Machine Company, Cincinnati, Ohio. Mr. J. C. Sterrett is general manager of the Seattle Ice Company.

SUBTRACTIVE PRODUCTION OF ARTIFICIAL DAYLIGHT.

By Herbert E. Ives and M. Luckiesh.

MOST forms of artificial light are very unlike daylight in color. Common illuminants, such as gas flames and incandescent electric lamps, have the color of incandescent solids at comparatively low temperatures, such as 2000 deg. C., while the color of daylight corresponds more nearly to an incandescent solid at a much higher temperature, about 5500 deg. C. This means that, when giving the same measured illumination, our common illuminants as compared with daylight are deficient in blue light and have an excess of red light. This difference is really very large, and were it not met by a comparatively great power of adaptation in the eye would seriously interfere with our comfort under artificial illumination. In Fig. 1 are shown the relative intensities of the various spectral colors in an average daylight (curve *a*) and in the tungsten lamp (giving one of the whitest of artificial lights) when the two are giving approximately the same illumination. Whatever disturbance of vision this change from daylight color may cause, there is one practical necessity which even the adaptive power of the eye cannot entirely meet, namely, the selection and matching of colors in materials such as paper, cloth or ribbon. If color combinations are to be used in daylight they cannot be made by artificial light, for matches and color harmonies under the one light are not such under the other. Purples (red plus blue), for instance, because of the deficiency of artificial lights in blue, appear under them of a red tinge. Blues look very dark or black, while reds are disproportionately bright as judged by their daylight values.

For certain technical purposes it consequently becomes of importance to secure artificial daylight for use in the absence of the natural article. One way of doing this is by the use of absorbing media over the lamps to absorb the excess of yellow and red radiation. This may be termed the subtractive method, to distinguish from the additive method, the latter being illustrated by the combination of a mercury-arc lamp with tungsten lamps. The nature of the absorption and the method of calculating the resultant loss in efficiency in this subtractive method

have been treated elsewhere by one of the present writers.[1] From that investigation it appears that the transmission of the absorbing screen should be the reciprocal of the relative brightness of the illuminant and daylight at each part of the spectrum. Since that work was done more extensive data have been ob-

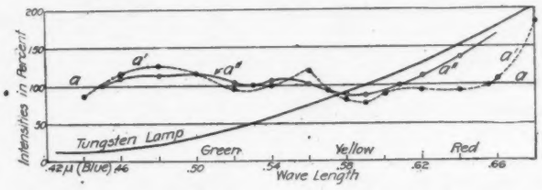


Fig. 1—Relative Intensities of Spectral Colors.

tained on the color value of daylight and on this basis the necessary absorbing medium to transform tungsten lamplight into "daylight" has been calculated. It should have the transmission throughout the spectrum shown in Fig. 2, curve *a*. Curve *b* shows the luminosity or brightness distribution in the tungsten lamp; curve *c*, the same after transmission through the medium *a*. Comparison of the areas of *b* and *c* shows the resultant candle-power to be 15 per cent of the original. This is the "daylight efficiency" of the tungsten lamp, and corresponds to about 10 watts per mean spherical candle.

The present paper is an account of an attempt to obtain colored glasses and other media approximating the curve *a*. Before describing the results of this work a few words are necessary as to the degree of exactness with which the requirements must be met; for it must be understood at once that none of the usual absorbing media may be expected to conform exactly in transmission to the curve *a*. In the first place attention must be called to the variable character of "daylight." Varying as it does from the deep blue of the clear sky, through the clear white of the noonday sun to the yellow of late afternoon sun and clouds, daylight is far from a definite thing. For purposes of specification an average may be chosen more or less arbitrarily—the curves of Fig. 2 represent what there is good reason for believing to be a fair average.[2] When the problem is that of producing artificial daylight the variability of natural daylight gives a certain latitude. The variation in daylight is of a perfectly definite character; it consists in a very uniform increase or decrease in the intensity of the spectrum toward one end or toward the other. An increase toward the blue end corresponds to blue sky; toward the red end, to low sun. As long, therefore, as the difference between the artificial and the average daylight given in Fig. 1 is of the nature of a progressive increase in intensity toward the blue end of the spectrum, or vice versa, the difference not being large, it will merely mean approximation to a slightly different quality of daylight and need not be serious.

Two physiological peculiarities of the eye eliminate the necessity for performing the practically impossible task of exactly reproducing the composition of daylight. First comes adaptation. If there is presented to the eye an illumination which approaches white in character the eye will quickly grow accustomed to it and will form a color scale to fit, just as a man in a wind will incline his body so as to preserve equilibrium. But while adaptation is of great assistance it cannot do everything, and if a radiation is missing, or nearly so, the eye cannot supply it entirely. Adaptation will not make it possible for the eye to distinguish purple from red under candle light, but if a light is nine-tenths of the way from candle light toward white, and of proper character, the eye may be depended upon to do the rest. The second physiological factor is the possibility of subjective or physiological mixture. Thus a white light can be matched by mixing merely red, green and blue, or by mixing yellow and blue. Consequently an artificial white might be made whose spectrum had several humps or depressions, yet the total light might be a good white. If, then, it be found impossible to avoid having certain bands of excess spectral transmission in the absorbing medium, it is often possible to distribute these so as to produce a white.

What characteristics should a "white" light have to make it suitable for color matching? While a white may be made in which certain colors are entirely missing, as stated above, such a light would be unsuitable for color matching; the fewer the colors present the less suitable would the light be. A two-color white (yellow-blue) would not illuminate a true red, and that color would appear black—a case corresponding very nearly to the mercury-vapor lamp. For the ideal white all the colors should be present and in the proportions of daylight. A study of the colors of most natural objects, however, reveals the fact that those colors are very rarely pure isolated spectral hues, but rather long diffuse bands of spectral light. A pure yellow is practically never met with in nature; in fact, yellow fabrics are all merely white minus blue and some green. As a consequence a white light consisting of isolated colors may yet possess enough colors to have very little disturbing effect on ordinary colored objects. Just how many spectral colors should be present is not a matter easily capable of exact statement, but certainly there should at least be the three—red, green and blue—and preferably more.

Now we may apply these general considerations, plus some experience and experiment, to the case of artificial daylight and state the following requirements:

1. The total light should appear white—that is, should have the integral color of such a spectral distribution as Fig. 1 indicates, or should vary from it by being only slightly bluer or redder in the manner that daylight varies.

2. All the spectral colors should be present, but if gaps or irregularities exist in the spectrum the three principal colors—red, green and blue—are necessary. Additional colors in equal, or nearly equal, intensity will improve the color-matching performance of the light.

These requirements fall far short of being exact specifications, but at present it is difficult to see how the various factors to be considered can be reduced to more exact terms. A rather large experience factor has of necessity been introduced in studying the problem. In the work which follows the deviations allowed from the desired character are justified, and under the circumstances can only be justified, by the experience of the writers as to the actual permissible amount of deviation from the conditions outlined above.

Some sort of blue glass or other medium is called for. Colored glass is preferable to dyed films or solutions of colored material, because of its practicability in handling and in permanence. The more diffuse and gradual absorptions of metallic salts are capable of incorporation in glass, and it is these, rather than the narrow absorptions of most dyes, that are called for in this problem. A study of a large selection of samples of colored glass revealed two shades which might be used—

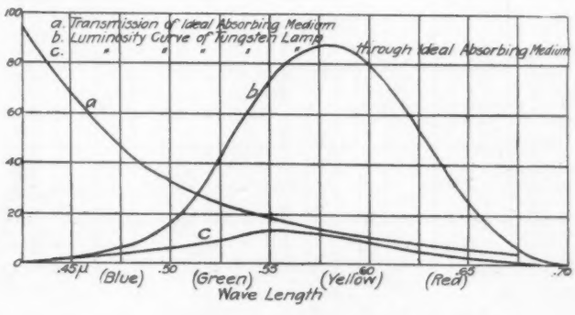


Fig. 2—Transmission and Luminosity Curves.

ordinary pot blue or cobalt blue and signal green. The first alone transmits blue, an isolated spectral band of yellowish green, and the deep red. Used alone over a tungsten lamp it gives a purple light, because of the transmitted red. Signal green alone makes the light too green, but it reduces the red that

[1] Herbert E. Ives, *Bulletin Bureau of Standards*, June, 1909
[2] *Trans.* Ill. Eng. Soc., March, 1910.

the cobalt blue transmits. A combination of the two appeared promising. Wedges of these glasses were ground and tested for transmission at various thicknesses on the spectrophotometer. From the measurements a combination of the two glasses was chosen which approximates the curve desired. A grave defect of this combination is the pronounced band of yellow-

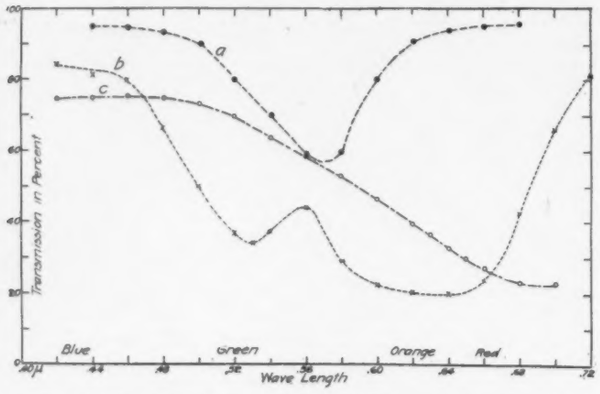


Fig. 3—Experimentally Determined Transmission Curves.

green transmission of the cobalt. In order to reduce this recourse was had to dyes. A peculiarity of the ordinary dyes is that their absorptions are very narrow and abrupt, so that they are not suited to securing the gradual absorption called for by Fig. 2, curve *a*. For the purpose of decreasing the transmission in a narrow spectral region, however, dyes are good. A dye—rozazeine—was found by trial which has an absorption band so situated as to cover very well the undesirable yellow-green band of the cobalt glass.

With these two glasses plus a gelatine film flowed upon one of them and containing a specified amount of dye an absorbing combination was obtained which produces with a tungsten lamp a very satisfactory approach to "daylight." In the spectrum the total light is "white." No gaps and no bad depressions or humps exist, and the three elevations are in red, green and blue. In short, the conditions outlined above are approximated.

The next question which arose was whether glasses could be obtained in stock thicknesses and depths conforming closely to the depth of color chosen from study of the wedges. Fortunately, two of the standard glasses carried by one of the large glass companies were quite near the desired character. The spectrophotometrically determined transmission curves of these, and of the dye in the depth used, are given in Fig. 3. Fig. 4

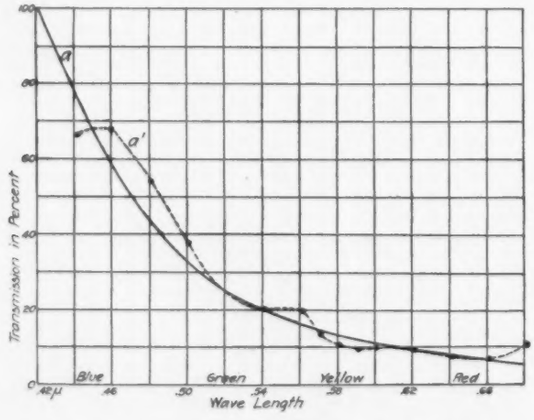


Fig. 4—Comparison of Transmission Curves.

shows the transmission of the combination, compared with the theoretical one, while Fig. 1 shows the spectrophotometric curve of this artificial daylight in terms of the average daylight used as standard. The full line *a"* is the combination obtained by study of the wedges of cobalt and signal green, the dotted line *a'* that of the glasses found upon the market. The latter glasses are of slightly different character from the cobalt and signal green, and give in some respects a better combination. Probably starting with these as a basis, it would be possible for a skilled glass worker to produce glasses even better, to combine these two in one, and perhaps even find a glass substitute for the dyed film. The latter would be especially desirable, as rozazeine is like many similar dyes in not being perfectly permanent.

With these glasses a "daylight window" has recently been constructed for the purpose of demonstrating the principle in a lecture on "artificial daylight." This consists of a tin box 16 in. x 12 in. x 20 in. holding six 60-watt frosted-tip tungsten lamps. The bottom of the box (16 in. x 20 in.) consists of the two glasses, one coated with the gelatine film containing the dye, the other a rough glass acting as a diffuser. The whole box rests upon legs 15 in. high. The surface to be illuminated is placed beneath, where an illumination of about 30 ft.-candles is obtained, this value being ample for purposes of color-matching. The color of this window has been measured on an Ives colorimeter, in terms of the average daylight, which was determined by one of the present writers[1] with that instrument. The readings—average daylight being equal parts red, green and blue—were:

Red	Green	Blue
100	85.4	75.8

These have been reduced to color sensation values by the method used in a former paper.[2] The sensation values, expressed so that their sum is unity, are:

Red S	Green S	Blue S
35.5	34.0	30.5

These are plotted in a color triangle (Fig. 5) along with several other illuminants. The center of this triangle is "average daylight," the corners are pure red, green and blue sensations, while the distance of a color from the center is a measure of its deviation from average daylight. On this scale of measurement and scheme of representation this particular artificial daylight is nearer the average daylight striven for than is any other artificial illuminant.

The window made up has proved extremely satisfactory on test. The light appears "white" and all colors assume their daylight appearance under it. It has been temporarily used for lighting a desk, and the soft white color has proved very pleasing. It constitutes a very satisfactory demonstration of the possibility of producing daylight by the subtractive method.

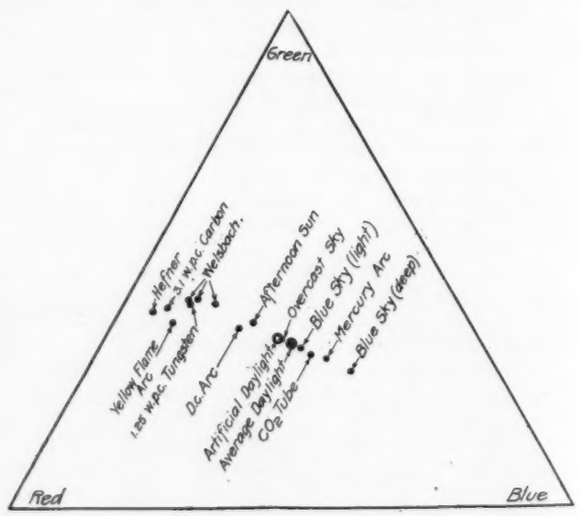


Fig. 5—Color Triangle.

The specific consumption is high, being from 10 watts to 12 watts per candle. On the other hand, the first cost is extremely low. Such a window may be used on an ordinary lighting circuit and its component parts are all easily renewable.

[1] *Trans.* Ill. Eng. Soc., November, 1908.
[2] *Trans.* Ill. Eng. Soc., March, 1910.

OPERATING 2200-VOLT DISTRIBUTION WITH 1100-VOLT TRANSFORMERS.

LAST February the People's Water & Light Company, of Harrisburg, Ill., changed its distribution e.m.f. from 1100 volts, single-phase, 60-cycle, to 2200 volts. This change was made to reduce distribution losses on the primary lines, the growth of the town making such a change imperative.

In this particular case an interesting condition was found in the fact that very few new transformers had to be purchased, even though there were a number of transformers which could not be reconnected for 2200 volts. Out of a total of fifty-two transformers with a rating of 254.8 kw there were thirty-nine with a rating of 216.6 kw which could be reconnected for 2200-volt operation. There were thirteen with a total rating of 38.2 kw which could be connected only for 1100 volts.

With the aid of a map of the distribution system plans were outlined whereby the 1100-volt transformers could be connected up in pairs with both primaries and secondaries in multiple while the plant was operating 1100 volts, and could afterward be changed so that the primaries could be connected in series and the secondaries remain in multiple, as before, when the change to 2200 volts was made.

It was found that the rating of the transformers in service was such that it was necessary to take only three of the 1100-volt transformers out of service in making the change. The other ten were banked in pairs. In some cases the secondary circuits were rebuilt so as to place more consumers on one secondary with a single transformer or pair of transformers to feed it instead of two or three transformers, as before.

After all the preparatory work had been done the actual change was made between daylight and dusk one Sunday, after previous notice to consumers that service would be off during the daylight on that day. It was thought that perhaps some of the 1100-volt transformers would burn out on account of the increased voltage between the primary coils and the grounded secondaries when the 2200-volt service was begun, but nothing of the kind occurred. The 1100-volt transformers were of the oil-insulated type. The secondary circuits were all grounded as a safety precaution before the change of voltage and the banking of transformers was made. Otherwise the risk of injury to consumers through defective insulation between the primaries and secondaries would have been more than the company would have cared to assume. The change was accomplished on the day designated without any mishap, although shortly after the work began a rain came up which made it necessary to hold parasols over the transformers while the lids were off for changing the connections. Simultaneously with the change of distribution voltage a new generator was being slipped into place at the power house. The change was made under the supervision of Mr. L. F. Payne, manager.

LARGE MOTOR LOADS.

By Alton D. Adams.

POPULATION is some measure of possible motor loads, but other important factors control in large degree the result. Some of these factors are illustrated in the seven motor loads of exceptional size relative to population that are here analyzed. Each of these motor loads is carried in connection with the regular lighting business by the general electric supply system in the city named.

That the motor loads here considered are of exceptional size relative to the respective populations served may readily be seen from the fact that they range from 73 to 155 connected horse-power per 1000 inhabitants, while the great connected motor load of 44,065 hp on the Boston system amounts to but 62 hp per 1000 persons in the cities and towns served.

Unfortunately it is not possible to carry the analysis of the Boston load very far, as many of the motors there are served through the same meters that supply lamps, so that lighting and motor outputs and incomes are too well mixed to be separated.

The seven electric supply systems that have been selected because of their relatively large power loads are located at Hartford, Conn.; Barre, Vt., and Springfield, Holyoke, Fitchburg, Attleborough and Greenfield, Mass. Figures relate to the rated power of connected stationary motors and to the income from this class of service in the fiscal year of 1909.

The seven connected motor loads range from 1350 hp in Greenfield, with its population of 11,268, up to 10,591 hp in Hartford, with an estimated population of 112,000. Populations given in Massachusetts are the figures of the State census of 1905. Springfield with its connected load of 6428 hp has the largest motor capacity of any city in the State outside of Boston, the next largest load, that at Lowell, being 5335 hp.

Barre, Vt., leads the group with 155 hp of motors connected for each 1000 of the population, and the lowest figure is 73 hp per 1000 at Holyoke. For Springfield the connected horse-power is 74 per 1000 of its 86,486 inhabitants, while the next largest load, at Lowell, represents 48 hp for each 1000 of the 110,786 people there. The Greenfield motor load is 120 hp and the Attleborough 127 hp per 1000 inhabitants.

Motor incomes per inhabitant range from $1.13 at Springfield to $3.66 at Barre, and Attleborough stands high with $2.71 on this basis. In income per rated horse-power of the connected motors Barre again leads with $23.68 and Greenfield foots the list with $13.36. Only one other plant, that at Attleborough, reaches $20.63 per horse-power.

For the five Massachusetts plants the average cents per kw-hour received for motor load varied from 1.82 at Holyoke to 2.85 at Attleborough. The average rating of the connected motors ranges from 4.7 hp in Attleborough to 12 hp at Holyoke.

The five Massachusetts plants under consideration have the largest connected motor loads in proportion to population of all in the State. At Hartford, Barre, Springfield, Holyoke and Greenfield a part of the electric supply was from water-power during the year named, and at Fitchburg and Attleborough all of the energy was generated by steam.

In the Hartford system 30 per cent of the energy was generated by water-power and the remainder by steam. The greater part of the 10,591 hp in motors there is used by the factories and is in the main a day load.

The Springfield electric system has two waterfalls within two miles of each other on the Chicopee River with a total combined fall of 50 ft. At the smaller of these two falls the energy generated during the year was 21 per cent of that in the entire electric system, and the output from both waterfalls was probably as much as one-half of the total. On both the steam and water-power stations the average load during the 8760 hours was 33.2 per cent of the maximum combined load of the year. This high average load was due to the 6428 hp of motor load that yielded an income of $15.21 per horse-power for the year with an average rate of 2.5 cents per kw-hour for the energy actually supplied.

Over 6000 hp of the motor capacity connected to the Springfield system was operated with three-phase alternating current, and the leading lines of manufacture were machinery, metals and printing. The average rate of 2.5 cents per kw-hour paid for motor load may be compared with the station cost of 0.8 cent per kw-hour for all energy generated in the Springfield system, including amounts paid for rent of water-power, but not including depreciation charges or salaries of officers. Soft boiler coal cost $4.37 per long ton for the year, and the cost of coal per kw-hour of all the energy generated by both steam and water was 0.32 cent beside the cost of the water-power.

At Barre the granite industry is the backbone of the notable load of 4650 rated horse-power in a service area with only 30,000 people. Three-phase alternating-current power is distributed and motors are used both at the quarries and in the granite-cutting sheds. Rates for energy to these motors are 4 cents to 2 cents per kw-hour according to the amount consumed per month, the rate of 2 cents applying where 2500 kw-hours or more is used per month. The average yearly income of $23.68 per horse-power from these motors is earned during

a working year of only about 2300 hours, or some 288 days of eight hours each, conforming to union regulations in the granite industry. Load-factors with these motors in the granite industry are high. Thus for the motors of one consumer 1485 kw-hours was used per rated horse-power during the year, and in another instance 1629 kw-hours was used per horse-power.

During the year the electric supply system operating these Barre motors generated 73 per cent of its total energy output at two water-power plants on the Winooski River, one at Middlesex and the other at Bolton Falls. The remaining energy was generated at the steam-driven plant in Montpelier.

In the Holyoke electric system a substantial but undetermined part of the energy is generated by water-power. Boiler coal cost $4.64 per long ton at the generating station and 0.59 cent per kw-hour of output in addition to the cost of water-power during the year. Rates for power ranged from 4 cents to 1.3 cents per kw-hour, and the average on the total sales for this purpose during the year was 1.82 cents, the lowest among the list of plants. On this rate basis the motor income was $16.48 per rated horse-power. The combined lighting and motor service gave a ratio of 26.6 per cent between the average and the maximum loads of the year. In this instance the figure of 73 motor-hp per 1000 of the population does not represent the entire capacity of the city to absorb electric power, as the Holyoke Water Power Company also distributes electric energy to motors in the same territory. More than 3500 hp of the 3667-hp total of connected motors on the Holyoke system are alternating-current type, and the average size of 12 hp, the largest in the list of plants, denotes their use in heavy manufactures, of which cotton goods and paper are the leading lines in that city.

Fitchburg power service yielded an income of $18.09 per connected motor horse-power during the year on rates that averaged 2.16 cents per kw-hour. The electric system showed a ratio of 30.2 per cent between the average and maximum loads for all classes of service during the year. In this system all of the energy was generated with soft coal and coke costing $4.88 and $4.07 per ton respectively. The fuel expense amounted to 0.74 cent per kw-hour generated, and the total station expense, including fuel, supplies, labor and repairs as charged, but not depreciation, salaries or general expenses, was 1.23 cents. A large percentage of the Fitchburg power sales were for operation of cotton-mill machinery at the rate of 1.8 cents per kw-hour, and there were more than sixty motor users.

The fiscal year for Fitchburg, like that of the other Massachusetts plants, ended with June 30, 1909, and the maximum station load of that year came at 5:30 p. m. on a December day with 57 per cent of the peak as motor load. On this same day, which probably required the maximum amount of lighting for the year, 60 per cent of the total station output went to the motor load.

Attleborough led all the Massachusetts plants with a connected motor load of 127 hp per 1000 inhabitants and a power income of $2.71 per person in the population. This load yielded $20.63 per rated horse-power and 2.85 cents per kw-hour consumed. Important among the factors contributing to these notable Attleborough results is the demand there for power in small units by a relatively large number of manufacturers of jewelry and silverware. This town of 12,000 people contained in 1905 108 manufacturing establishments, or 1 per cent of the total number in the State, and the average capacity of installed engines and waterwheels in all these establishments was only 35 hp each. For the 348 motors connected to the electric system the average capacity was 4.7 hp, the lowest among the list of plants, while in Boston, where the proportion of small motors is naturally large, the average size is 4 hp.

All of the electric energy at Attleborough was generated by steam coal that cost $3.87 per long ton and 0.68 cent per kw-hour generated for all purposes. The total station cost on the same basis was 1.09 cents per kw-hour. For the combined lighting and power business the average load during the year was 22.1 per cent of the maximum.

In Greenfield the high figure of 120 connected motor horse-power per 1000 of the population was obtained with an average income of $1.60 per inhabitant and $13.36 per rated horse-power, this latter figure being the lowest in the list. The average rate per kw-hour used by motors was 2.83 cents, while the station expense for all energy generated by steam and water-power combined was 0.6 cent per kw-hour. The average load for the year was 25.3 per cent of the greatest.

LARGE MOTOR LOADS DURING 1909.

Location of Plant.	Popula- of Cities Served.	Motor Horse-power Con-nected to Plant.	Motor Horse-power per 1000 Popula-tion.	Motor Income per In-habit-ant.	Motor Income per Horse-power.	Average Cents per Kw-hour Motor Load.	Average Rating of Motors in Horse-power.
Hartford....	112,000	10,591	94	$1.83	$19.47	....	....
Springfield.	86 486	6,428	74	1.13	15.21	2.50	8.3
Barre... ..	30,000	4,650	155	3.66	23.68	...	...
Holyoke....	49,934	3,667	73	1 21	16.48	1.82	12 0
Fitchburg .	33,021	2,771	84	1.52	18.09	2.16	9.1
Attleboro...	12,702	1,621	127	2.71	20.63	2.85	4.7
Greenfield .	11,268	1,350	120	1.60	13.36	2.83	5.3

In the above table the more important figures for the seven motor loads under analysis are combined.

HYDROELECTRIC DEVELOPMENT IN CANADA.

Station of the Erindale Power Company, Ltd., on the Credit River at Erindale, Ont.

THE hydroelectric station of the Erindale Power Company, Ltd., of West Toronto, Ont., was placed in operation last September. It has many features of interest, chief of which is the peculiar formation of the power-house structure, resulting in a materal reduction in initial cost. The station is located at Erindale, on the Credit River, 4 miles from Lake Ontario. The river rises in the hills 75 miles back of the lake, and has a minimum flow of 120 cu. ft. per second.

Fig. 1—Portal of Intake Tunnel Leading to Power House.

A dam is thrown across the river, which, as shown in Fig. 4, turns on itself in a very short distance. The structure, which is 700 ft. long, comprises a 100-ft. concrete spillway, the remainder being an earth embankment with a core wall of reinforced concrete 8 ft. wide at the bottom and 2 ft. wide at the top. In addition there are buttressses spaced every 20 ft. along the embankment. The core wall when complete will be 40 ft. above the riverbed, and the spillway 34 ft. above the riverbed. The foundations are set 18 ft. below the bed of the river. Three sluiceways are provided at one end of the spillway to handle extreme floods in spring.

By means of the dam a lake is impounded covering a section of 125 acres and yielding a head at the station on the other side of the hill ranging from 53 ft. to 60 ft. The portal to the tun-

nel leading to the power house is built of reinforced concrete, 24 ft. square and 33 ft. high, with two 7-ft. x 10-ft. openings for gates. The latter are made of wood, and behind them is a coarse rack having a steel section at the bottom and an upper section of wood. The idea of this composite rack is to prevent ice freezing to it, and thus to eliminate troubles from anchor ice.

The tunnel leading under the hill from the portal to the

Fig. 2—Down-Stream Side of Dam Across Credit River.

bulkhead back of the station is 900 ft. long and 12½ ft. in diameter. It has a horseshoe cross-section and is made of reinforced concrete. Four hundred feet of it pass through shale and the remainder through clay and quicksand. The tunnel has a minimum thickness of 18 in., which was increased as the occasion demanded. At the end of the tunnel, just as it emerges into the bulkhead, there is another rack made of steel.

The bulkhead, as is shown in Fig. 6, has a fan-like shape, the penstock to the waterwheels leading directly from it with a straight drop of 24 ft. from the floor of the tunnel to the wheels. The latter are single-runnner, horizontal Canadian machines, discharging through the side of the penstock toward the power house through a 90-deg. turn in a draft tube to the tailrace 9 ft. below the power house, whence the water is returned again to the river. The Canadian runner has vanes which stand out to the full diameter of the case and receive a live stream of water in impact throughout their depth, carrying it naturally downward to a curved discharge bucket, on which it reacts in leaving the wheel. The turbine therefore belongs to the full-diameter or Swiss-type machine. It is provided with

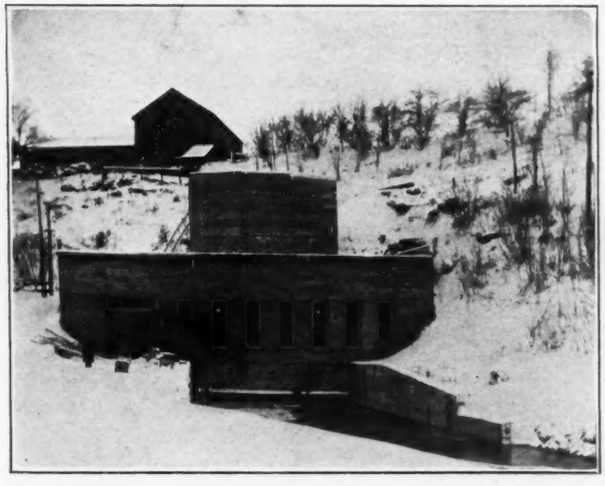


Fig. 3—Bulkhead, Power House and Tailrace.

alternate moving and stationary gates, the moving gates being balanced on a heavy steel pivot pin fully equipped for adjustment. In the Canadian wheel the area of the discharge is just equal to that of a cross-section at the named diameter, while with the American type of wheel the discharge area is expanded to more than double that of the named section. The wheels, which are of the combined impulse and reaction type, 50 in. in diameter, were built by Charles Barber & Sons, Meaford, Ont., and are rated at 840 hp when operating under a head of 56 ft. At present the wheels are operating under a 53-ft. head, which

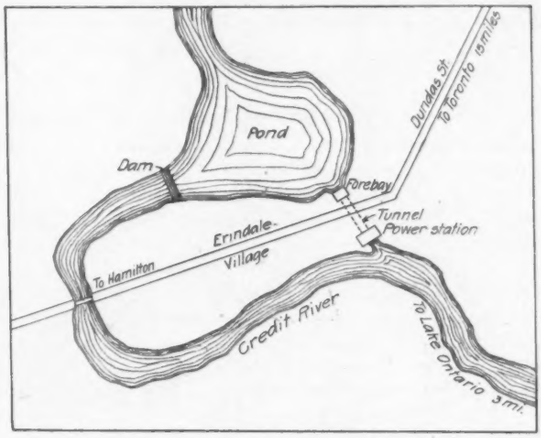


Fig. 4—Location of Plant.

will be increased to 60 ft. in the course of a few weeks. Each wheel is controlled by a Woodward governor and is connected to an Allis-Chalmers-Bullock three-phase, 60-cycle, 13,200-volt machine running at 200 r.p.m. The radial system employed in the layout of the equipment allows plenty of space at the generators, where it is needed, and just as much space as is required at the waterwheels. In fact, a parallel arrangement would not possess any added advantages. By means of the type of construction employed at the bulkhead and penstock a saving of approximately $8,000 was effected.

The development was started by a Toronto company organized by the York Loan Company a little over six years ago. This company completed about two-thirds of the tunnel and the

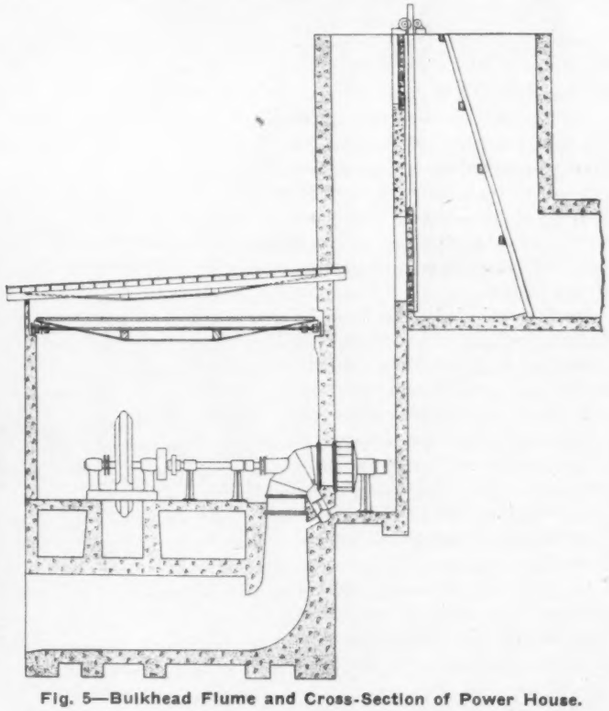


Fig. 5—Bulkhead Flume and Cross-Section of Power House.

foundations of the dam about one-third way across the river. It also purchased the two generators, but while the latter were still on the flat cars the company failed, and nothing was done for four years. The Erindale company bought in the property at receiver's sale and, although the generators stood outside

exposed to the weather just as they came from the shop for over four years, the construction was such that not a coil broke down when they were placed in operation. In drying out the

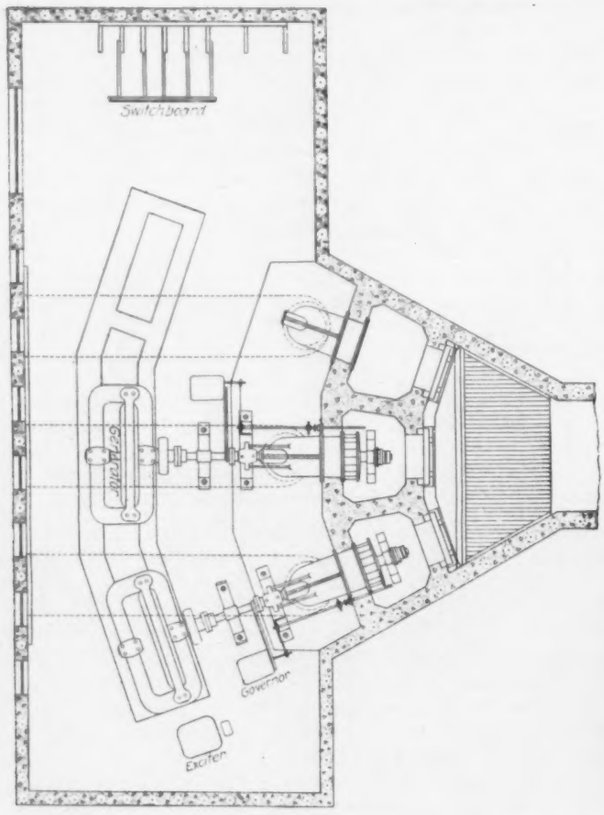


Fig. 6—Plan of Power-House Bulkhead and Flume, Erindale Power Company.

machines a bridge megger was used with excellent results. At the start the insulation resistance was so low that the instrument would not record it, but after operating on a short-circuit under 150 per cent full-load current for 195 hours a reading of 8 megohms was obtained. Operation under these conditions was continued until a final reading of 150 megohms was obtained at the end of 315 hours.

The switchboard was built by Messrs. Ferranti, of England, and comprises two generator panels, two feeder panels and one exciter panel. The high-tension oil switches on the generator and feeder panels are manually operated and have brush contacts. The switches with the series transformers, shunt transformers, conductors, etc., are placed in concrete cells 9 ft. back of the panels. The exciter panel has main switches for connecting with three exciters, which may be operated in parallel, and the direct-current busbars run across the generator panels and connect with the field switches of the machines. Lightning arresters of the spark-gap and arrester type are connected to the line through disconnecting switches.

A wooden-pole line carrying a single circuit of No. 0 aluminum wire on Locke porcelain insulators, spaced 24 in., connects the Erindale station with a substation in West Toronto, 15 miles distant. Thirty-foot wooden poles are used, and these are spaced about 130 ft. apart. The potential is stepped down to 2200 volts, two-phase, in T-connected Allis-Chalmers-Bullock transformers rated at 300 kw each and located in the station of the Interurban Electric Company in West Toronto. For the purpose of improving the power-factor of the system a 300-kw, two-phase, 60-cycle S. K. C. over-excited synchronous motor is provided in the substation.

At New Toronto there are two 200-kw transformers wound for 13,200 volts primary and 2200 volts secondary, built by the Canadian Westinghouse Company. A third transformer of similar capacity is held in reserve, and all are protected by expulsion fuses and Garton-Daniels lightning arresters. At Swansea there are two 250-kw transformers, built by the Canadian General Electric Company. At Humber the Interurban Electric Company, which is closely affiliated with the Erindale Power Company and purchases its entire output, operates a combination plant comprising four generators, four engines, two pairs of waterwheels and seven boilers. There are two 180-kw, two-phase, 2200-volt, 60-cycle machines belt-driven from 36-in.

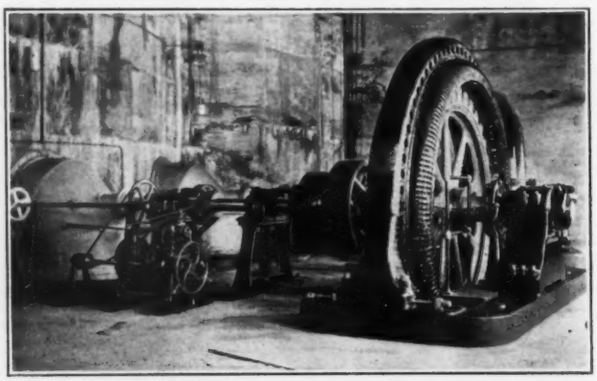


Fig. 7—Interior of Generating Station, Erindale Power Company.

waterwheels, operating under a head of 25 ft., and there is an 180-kw machine belt-driven from a Robb engine. In addition

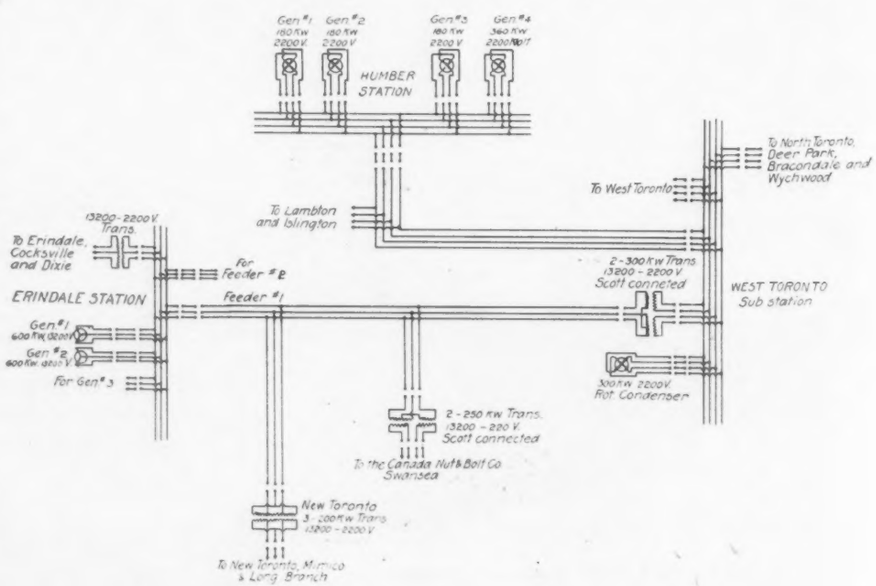

Gen.#1 180 Kw 2200 V
Gen.#2 180 Kw 2200 V
Gen.#3 180 Kw 2200 V
Gen.#4 360 Kw 2200 V
HUMBER STATION
To North Toronto, Deer Park, Bracondale and Wychwood
To West Toronto
To Lambton and Islington
13200-2200 V. Trans.
To Erindale, Cooksville and Dixie
for Feeder #2
Feeder #1
ERINDALE STATION
Gen.#1 600 Kw 13200 V.
Gen.#2 600 Kw. 2200 V.
For Gen.#3
2-300 Kw Trans. 13200-2200 V. Scott connected
WEST TORONTO Sub station
300 Kw 2200 V. Rot. Condenser
2-250 Kw Trans. 13200-220 V. Scott connected
To the Canada Nut & Bolt Co. Swansea
New Toronto 3-200 Kw Trans. 13200-2200 V.
To New Toronto, Mimico & Long Branch

Fig. 8—Diagram Showing Transmission and Distribution System.

one of the 180-kw machines belted to the waterwheels is connected through a friction clutch and belt to a buckeye engine and the other is similarly connected to a tandem-com-

pound Robb engine. The fourth unit is rated at 360 kw, and is driven direct from a cross-compound Robb engine. The electrical equipment of the Humber station was furnished by the Canadian Westinghouse Company. The engines operate condensing and receive steam from six return-tubular boilers rated at 150 hp each and one water-tube boiler rated at 200 hp. The boilers were built by the Canada Foundry Company and operate under a pressure of 120 lb. A two-phase, four-wire line of No. 00 copper and a duplicate line of No. 3 copper connect the Humber station with the substation at West Toronto. The connected load on the combined system comprises about 2500 hp in motors ranging in rating from 50 hp to 1 hp, 28,000 incandescent lamps and 150 arc lamps. The rate for motor circuits is $15 per hp-year for ten-hour loads and 2 cents per kw-hour on a meter basis. The rate for lighting is 8 cents net. The Interurban Electric Company, Ltd., distributes the energy in West Toronto, North Toronto, New Toronto, Wychwood, Swansea, Islington, Erindale, Cooksville, Dixie, Long Branch, Mimico and Lambton. The company is at present negotiating for the purchase of 1000 kw in bulk and will then use its water-power station at Erindale for peak-load service, storing the water in the pond formed by the dam for this purpose.

The officers of the company are as follows: Messrs. Charles Holt, president; J. Kirkes Meyers, vice-president; H. Waddington, director; Eli S. Edmondson, managing director, and Thomas Henry, chief engineer and superintendent.

ELECTROLYTIC PURIFICATION OF BOTH WATER AND SEWAGE AT OKLAHOMA CITY.

AN electrolytic plant capable of treating 750,000 gal. of sewage in twenty-four hours has been in operation in Oklahoma City, Okla., since March 29, and the water-works department is beginning to install electrolytic apparatus for manufacturing precipitate capable of treating 4,000,000 gal. of water supply in twenty-four hours, replacing in part the lime-and-iron process now in use there. Both of these plants, though using distinctly different processes, are in the nature of experimental installations, and the success of their operation will determine the use of similar equipment capable of handling respectively the entire water supply and sewage disposal of the city. The preliminary installations, however, are on a large scale, well adapted to show the operation of the systems in full size. In the case of the water-works 40 per cent of the 10,000,000 gal. now pumped daily is being arranged for electrolytic precipitation, while the present sewage-disposal apparatus comprises about one-fifth that necessary to treat the entire discharge of the city, which drains into several different basins.

At the city water-works plant two 60-hp motor-driven low-duty centrifugal pumps lift the water from the level of the creek to that of the sedimentation basins and storage wells, from which the high-duty steam pumps force it into the city mains at 60 lb. pressure per square inch. This pair of low-duty centrifugal pumps, which as now motor-driven at 475 r.p.m. are together capable of handling 15,000,000 gal. a day, were formerly individually driven by 400-r.p.m. steam engines. The substitution of the motor drive, operated from a pair of 150-kw four-valve engine-driven 220-volt direct-current generators, has not only increased the output and efficiency of the centrifugal pumps themselves, but the steam taken by the engine-generator sets—operating the pumps, plant and grounds lighting, filter-washing pumps, machine shop, etc.—is even less than that formerly required by the pump engines alone.

The water supply of Oklahoma City is now purified by a precipitation process, hydrate of lime and iron sulphate being added to form a floccular precipitate which settles to the bottom during its passage of a long settling basin, the precipitate carrying with it the impurities and other foreign material present in the solution. Iron sulphate, a by-product of steel manufacture, is the expensive ingredient of the above process, and it is the purpose of the electrolytic apparatus to produce an equally effective precipitate from such simple materials as iron borings and table salt at reduced cost. The scheme thus involves making the precipitate by electrolysis in a voltaic cell outside the settling tanks, afterward adding this flocculant to the water, just as is done with that made from the more expensive lime and iron mixture. The new electrolytic equipment is being installed under the direction of Mr. V. G. Shinkle, engineer and manager of the Oklahoma City water supply department.

SEWAGE DISPOSAL.

The electrolytic scheme used at the local sewage-purification plant, which was started March 29, 1911, is an adaptation of that employed at Santa Monica, Cal., and is the only plant yet erected outside of the original installation on the Pacific Coast. In this process the raw and untreated sewage is directly traversed by large low-voltage currents, the electrolysis of the solution liberating nascent elements which speedily effect the conversion of objectionable matter present. A 7½-hp, 220-volt alternating-current motor, operated from the Oklahoma City Gas & Electric Company's lines, drives the 3-kw direct-current generator shown in Fig. 1, which is capable of delivering currents up to 900 amp at 1.5 volts to 3 volts. The third machine on the shaft is the exciter for the low-voltage generator which supplies the large currents for electrolyzing the sewage.

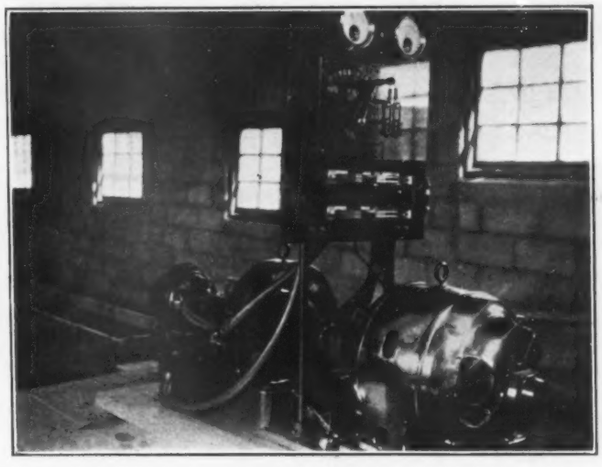


Fig. 1—Motor-Generator Set Supplying 900 Amp. for Electrolytic Purposes.

The electrodes are 10-in. x 24-in. x ⅜-in. iron plates, grouped in batteries of twenty-seven as shown, adjacent plates being of opposite polarity, and ten such batteries being installed in each flume through which the sewage flows. Each such flume is designed to treat 250,000 gal. per twenty-four hours, the three flumes making the present capacity 750,000 gal. a day. Heavy copper busbars convey the current from the low-voltage generator to the copper channel caps on each plate, the travel of the current through the sewage electrolyte being about 0.5 in. The copper caps on the plates increase their conductivity and also aid electrolytically in the purification process. The group of 270 plates in one flume requires a current of about 270 amp at 2.5 volts, 1 amp per 24-in. x 10-in. plate being found the best operating current density. When the current is turned on the electrolyte over the plates quickly becomes milky with fine bubbles of hydrogen and oxygen. The latter, in its nascent form, attacks and destroys objectionable organic compounds present in the water and oxidizes other materials, while the ferric oxides also formed are said to exert chemical effects adding to the purifying action.

After the electrolytic action has proceeded in one direction from twelve to twenty-four hours, and sludge has collected about the cathodes, the direction of current flow is reversed, cleaning the former cathodes and also reducing unequal destruction of the anodes. Bacterial ratios are said to be decreased from 700 to 7; the nitrates are reduced from 7 to 4 and largely

converted into ammonia, while the phosphates remain unchanged and assimilable.

Using 900 amp at 2.5 volts, or 2¼ kw, to treat 750,000 gal. per twenty-four hours in the three flumes, the cost of operation of the present disposal plant, at 4 cents per kw-hour, would be $2.16 per day, or $790 per year. This represents energy consumption only and does not include renewals, labor, etc.

The present purification plant at Oklahoma City has been

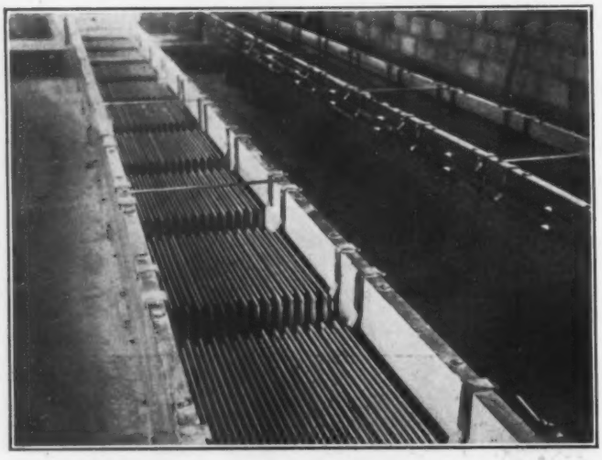


Fig. 2—Flume Containing Electrode Plates for Electrolysis of Sewage.

installed, under agreement, without cost to the city pending its satisfactory operation and acceptance. In the event of the adoption of the system for sewage disposal five similar equipments will be required at different points on account of the diverse channels of sewage drainage at Oklahoma City. The Oklahoma law regarding stream pollution requires that the sewage be rendered innocuous in some way. A large septic tank was first provided in the case of the sewer whose contents are now treated electrolytically, but even with this tank foul and putrefactive products were discharged into the stream. The electrolytic sewage-disposal plant at Oklahoma City was installed by Mr. A. J. McMahan, under patents issued to Messrs. C. P. Chandler and L. G. Lautzenhiser, of Santa Monica, Cal., where the first plant of this kind is in use.

LENTZ POPPET-VALVE STEAM ENGINE IN GALESBURG (ILL.) LIGHTING PLANT.

As a result of the attention which the steam turbine has received in this country during the last five years progress in the development of the reciprocating engine has been partially lost sight of. In the smaller sizes, however, the reciprocating machine is still able to hold its own with all other comers in the steam field, while, indeed, in Europe improved types of engines have been developed, and are in general use, that give economies of performance and steam consumption that are unknown to the average American plant engineer. Among these improved forms of engine, reports of which have been given in the *Electrical World* from time to time, are the Wolf locomobile and Lentz machines, the last named of which is now built in this country under foreign license.

A Lentz engine of American manufacture has just been erected in the municipal street-lighting station at Galesburg, Ill., where it drives a 200-kw, 2300-volt, 60-cycle alternator. The engine is of the tandem-compound, condensing type, with poppet valves operated from a cam shaft, and resembles in general outlines the familiar horizontal, tandem, double-acting type of gas engine.

The Galesburg engine is rated at 240 hp, but is capable of developing 300 hp. Its high-pressure and low-pressure cylinders are 13½ in. and 23 in. in diameter respectively, with a stroke of 21 in. The comparatively high speed at which the engine runs, 164 r.p.m., enables a smaller and less costly type of alternator to be used than would be required at a lower speed. Steam at 160 lb. per square inch pressure and containing 125 deg. of superheat is obtained from a new installation of two 300-hp Erie vertical water-tube boilers, capable of delivering 100 per cent overload. Each boiler comprises an upper and lower steel drum connected by vertical tubes, the entire boiler being suspended from the upper drum with the lower drum free. Baffle plates conduct the heated gases from the Dutch-oven furnace through the tubes in three passes. The tubes are mounted at 5-in. and 6-in. distances, so that any tube is accessible for repairs if necessary. These boilers also supply steam for a 140-hp Corliss engine driving three arc generators through a jackshaft and for a 25-hp high-speed engine.

The Lentz engine is operated condensing, exhausting into a Dean jet-type condenser. Complete, this 240-hp engine weighs 48,000 lb., but on account of its reduced weight of moving parts it is carried on an extremely light concrete foundation, the construction of which makes all parts of the engine accessible. Operated condensing the engine is guaranteed to develop a hp-hour on 2 lb. of coal.

In construction this engine presents many novel features of design. The accompanying illustration reveals its general resemblance to the horizontal type of gas engine, with cam-operated poppet valves, etc. In this steam engine, however, the cam-shaft speed is, of course, the same as that of the engine, instead of half engine speed as in the gas engine. The admission valves are at the top and the exhaust valves below, all being cam-operated for both the high-pressure and low-pressure cylinders.

Throughout the entire engine no elastic packing is used, the stuffing boxes being formed by a series of cast-iron rings, turned and ground within 0.001 in. and fitted into the carefully bored stuffing box. These rings do not touch the piston rod, but inserted between them are several "floating" square-sectioned rings which fit the rod to an accuracy of 0.001 in. The rings thus form a series of chambers. Any steam escaping from the first chamber is expanded and condensed in the next, and so on, each chamber being automatically drained of its condensed water. Oil may be kept circulating in the stuffing box if necessary, but the water of condensation is itself sufficient

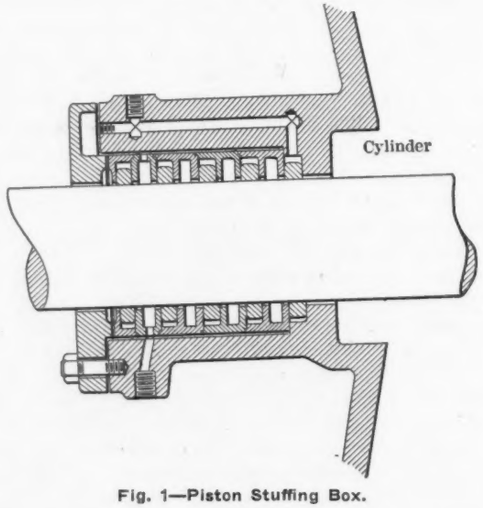


Fig. 1—Piston Stuffing Box.

to prevent leakage and no leakage is shown past the outermost ring.

The valves are of the double-seated drop type. No packing is used on the valve spindles, but they are also ground to fit, within 0.001 in., the long bushings through which they pass. The cam roller is in contact with the cam except when the valve is seated, so that the operation of the cam movement is practically noiseless.

The full-speed cam shaft is driven from the engine shaft by bevel, steel friction wheels pressed tightly together. To prevent slips, however, teeth are cut at one side of the wheels and these extend beyond the friction surfaces, meshing to provide driving action. The eccentrics for each of the eight valves are mounted on this cam shaft, and by a sliding-wedge arrangement in the shaft the throw of the eccentrics can be varied over any value, from zero to their maximum crank effect. The motion of this sliding wedge is controlled by a combined inertia-centrifugal governor also mounted on the shaft. Inclosing the flyballs of this governor is a heavy inertia ring, attached to the flyball motion through knee-joints in such a way that any slight change in speed (which reacts first on the inertia ring before affecting the balls) will assist the throw of the flyball movement. As a result of this unique application of the inertia principle the operation of the governor is very rapid and close speed regulation is obtained over sudden and large changes in load. By means of a handwheel on the governor shaft, controlling the eccentric wedge motions, the governor can be set at any predetermined speed while the engine is running. The governor is set to control the speed within 2 per cent throughout the entire range from full load to no load.

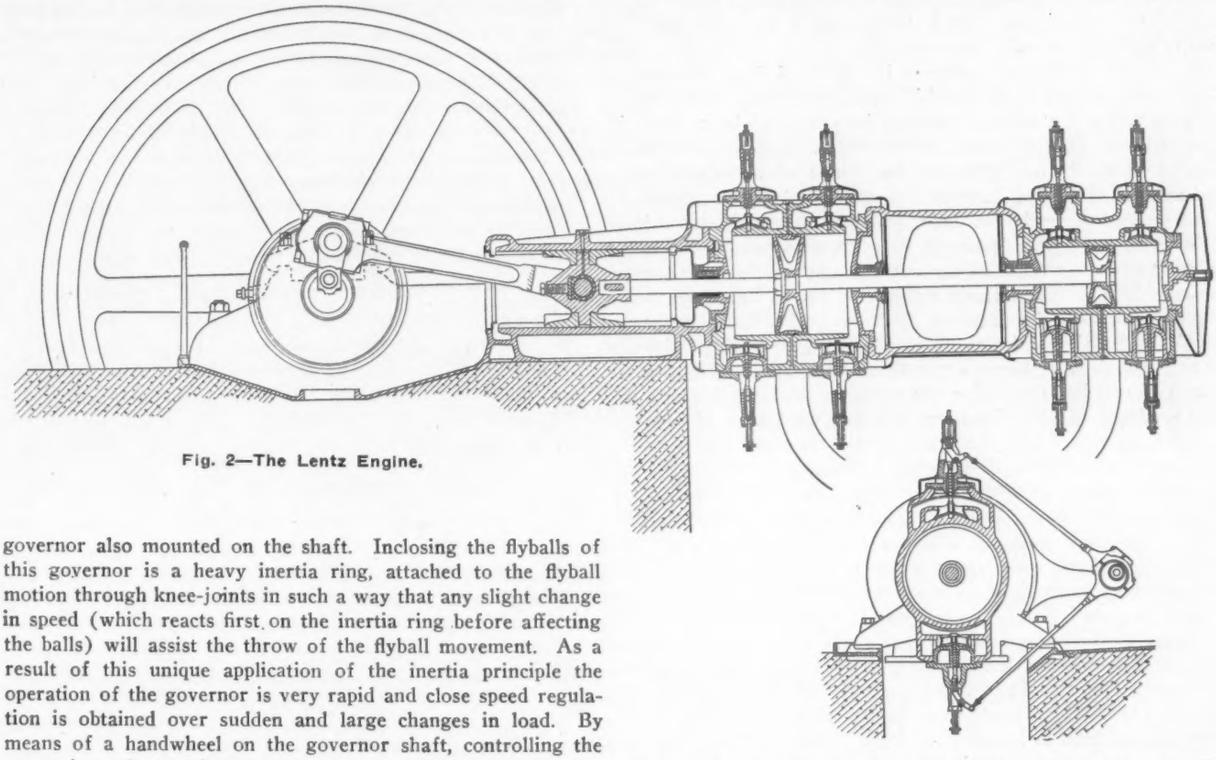


Fig. 2—The Lentz Engine.

The Lentz engine at Galesburg, Ill., together with the new vertical boilers, was built by the Erie City Iron Works, of Erie, Pa., and was installed by W. A. Day & Company, Chicago. Mr. W. A. Knutzen is city electrician of Galesburg and has charge of the street-lighting plant, in connection with which this engine is in use.

SHORTENED STANDPIPE SOLVED WATER-HAMMER TROUBLES.

The 1000-kw hydroelectric plant of the White River Power Company at Ashland, Wis., is located at the end of 1350 ft. of 9-ft. supply pipe, which throughout its length from the dam to its down-stream end (where it drops suddenly 20 ft. toward the waterwheels) is nearly horizontal, having a grade of barely 6 ft. in the 1350-ft. distance. Engineering experience would indicate that such a pipe line should be laid at a uniform angle from the dam to the wheels, but this portion of the installation was made by a local contractor who completed the work before engineering advice was invited upon the undertaking.

From the end of the nearly level pipe, therefore, the 9-ft. penstock bends suddenly downward entering, at an angle of 40 deg., the steel-plate receiver, 9 ft. in diameter and 23 ft. long, situated just behind the rear wall of the generating station. From this receiver are led the supply pipes to the two 900-hp Morgan Smith twin 24-in. runner, wicket-gate turbines, driving the two 500-kw, 2200-volt Westinghouse alternators. These 900-r.p.m. units are controlled by Lombard type-D oil-pressure governors. There is one belted exciter and one waterwheel-driven exciter, the latter unit being equipped with a Woodward mechanical governor. From the wheels the discharge water passes through steel-plate draft tubes 12 ft. long to the tail-race.

As was to be expected from the long horizontal penstock pipe ending in the short inclined section, considerable water hammer developed with changes of load on the equipment. The decrease in gate aperture caused by a reduction in load of 75 kw or 100 kw produced inertia effects in the waterwheel lines that were quite terrifying to those operating the station. Such enforced changes in velocity of the water in the 1350 ft. of 9-ft. pipe developed tremendous pressures, water being even forced from under the bolts and rivets of the receiver and waterwheel casings.

To remedy this state of affairs, it was determined to erect a standpipe at the end of the long horizontal flume, where the latter started its downward plunge. An opening was cut in the top of the pipe, and from this, surrounded by a reinforcing header of heavy concrete, a 13-ft. vertical standpipe was carried up to a point about 8 ft. above the crest of the dam. The unusually large diameter of standpipe, 13 ft., rising from a 9-ft. header, was selected to insure the proper accommodation of the overflow water delivered by the heavy hammer effect. The standpipe was carried 8 ft. above the dam in an effort to save the spilling of water that would otherwise take place during heavy rises in the pipe.

With the new standpipe in position, efforts were again made to operate the waterwheels, but the same hammer effect asserted itself almost as badly as before. It was then realized that the increased head due to the water rising in the standpipe caused almost as much regulation trouble as the unspent inertia effect of the flume contents itself, so it was accordingly proposed to shorten the standpipe to a point where this effect would cease, even at the expense of spilling water over the top of the pipe. The standpipe was accordingly cut off, a foot at a time, until a point was reached, about 2 ft. above the level of the dam, at which the governing action of the wheels took place without water hammer, and from this time on the plant operated successfully.

NOTES ON THE ECONOMICAL PRODUCTION OF STEAM.

By John B. C. Kershaw.

IT may sound like a truism to assert that all types of boilers should be reserved solely for the production of steam. In view of the general practice of using boilers for purifying and warming the feed water, it may be as well to reassert the opinion of those best qualified to judge results that a boiler is designed for making steam and that to use it for other purposes is neither economical nor wise.

The amount of steam which can be produced from a clean boiler, fed with water at the boiling temperature, is double and even treble the amount that can be generated by a dirty boiler fed with cold or merely warm water. Not only is the efficiency of the boiler (measured in pounds of water evaporated per pound of fuel from and at 212 deg. Fahr.) increased by this method of work, but the expenditure upon cleaning and repairs is reduced, since less scale and dirt are separated inside the boiler and the strains set up by temperature differences are reduced. Even if the calcium salts be separated in the form of mud, which can be removed by blowing down the boiler periodically, it should be remembered that heat is lost with every gallon of water blown off in this way. The less blowing down is resorted to the higher the efficiency of the boiler as a steam producer will be. To secure the best possible conditions for steam production in boiler working it is therefore necessary to maintain as far as practicable clean boiler plates or tubes and an adequate supply of feed water raised to the temperature of the water inside the boiler. The importance of clean boiler plates is generally recognized in so far as this relates to freedom from hard scale on the water side of the plate, and most engineers in charge have their boilers periodically blown down and cleaned from adherent scale. It is doubtful, however, whether the question of using a purer water supply and scaling less frequently is sufficiently studied in its economic aspect. If a boiler could be run for ninety days instead of for thirty days before blowing down and cleaning were required the saving effected both in labor and the heat losses involved when a boiler is laid off for cleaning might more than balance the extra cost of the purer water supply. This question is one, of course, which can only be studied with all the data for each separate installation, and every engineer must therefore work out the answer for himself. A naturally pure water is required for the experiment. A water that has been chemically purified is hardly suitable for boiler working on these lines, since the salts which accumulate in the boiler, though soluble, may cause damage as they become more concentrated. Another point in relation to this question of clean boiler plates or tubes that is often overlooked is that boiler plates and tubes have two sides and that, while the importance of keeping the water side clean and free from thick deposits of scale is generally recognized and acted upon, the possibility of the heat side of the plates or tubes being equally dirty and in need of chipping is rarely acknowledged. It is a fact, however, that considerable gains in boiler efficiency have been obtained by thoroughly cleaning the fire side of the tubes of water-tube boilers. It is not merely that soot and dust collect in angles and places where the design makes a kind of pocket, but a hard scale often forms on the outside of plates and tubes, which can only be removed by chipping. The practice of sweeping the soot and dust from the sides and bottom flues and plates of the boiler when blown off for cleaning purposes should therefore be supplemented by scraping and chipping the fire side of plates and tubes when any hard incrustation is found upon these which might retard heat transmission. In this connection it is useful to note that soot is a very bad heat conductor and that plates or tubes coated with soot lose from 25 per cent to 50 per cent of their conductivity. The gains due to smoke prevention or abatement are therefore not entirely confined to the promotion of cleaner skies outside, but extend to the internal condition of the boiler and lead to increased efficiency.

As regards the actual gains in efficiency due to the use of a feed water at the temperature of the boiler much has been printed in the technical press bearing on this subject. The writer is one of those who believe that the gain is now actually established and that the answer to the question, Why does a boiler plate or tube transmit heat more rapidly when the water in contact with it is boiling than before it has attained the temperature of ebullition? is to be found in the diagram shown herewith. This represents the curve of the heat units absorbed by 1 lb. of ice at the absolute zero of temperature in its passage from the solid through the liquid to the gaseous state compared with the similar curve for steel when heated through the same range of temperature. The portion of the curve marked *D E* is that which calls for study in connection with this question, since it represents the heat absorption (966 lb.-Fahr. units) which accompanies the conversion of 1 lb. water at 212 deg. Fahr. into steam at the same temperature. Now it is evident that the heat absorption from the source of heat at this point in the production of steam from water must be much more rapid than when the water or steam is receiving what is known as

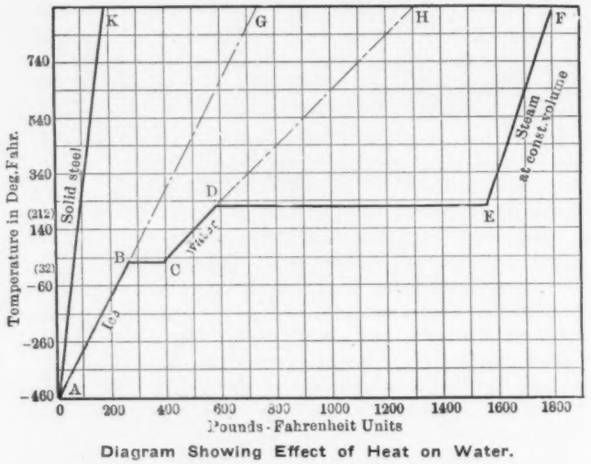


Diagram Showing Effect of Heat on Water.

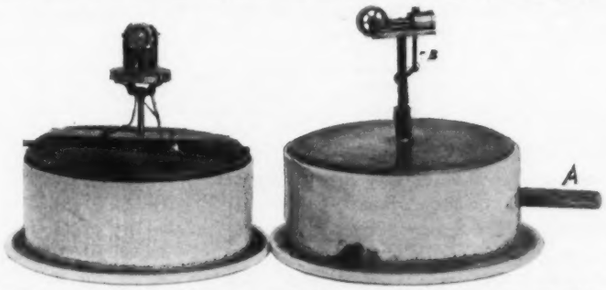
sensible heat—that is, heat which can be measured by a rise in the thermometer. The water side of the plate must lose more heat in a given period of time, and thus be more quickly cooled, than when no steam is being made, for steam is a more mobile fluid than water and will escape more quickly from contact with the heated plate. There is no contradiction of the law that the rate of heat flow is proportionate to the square foot of the temperature difference between the two sides of the steel plate or tube, for when ebullition is occurring this temperature difference is greater and the rate of heat flow is greater. The classical observations of Sir William Anderson in 1872 may be referred to here. The writer has proved the correctness of these observations by laboratory experiments, using glass vessels, and has no reason to doubt that similar results would have been obtained with iron or steel vessels.

Those engineers who have persisted in their disbelief of the accuracy of the figures for actual steam-raising trials showing greater boiler efficiencies with hot boiler feed than with cold feed, because this was, they supposed, in contradiction to the law of heat-transfer, will, it may be hoped, change their attitude in this matter and be prepared to accept hot boiler feed as one of the most important factors in obtaining high boiler efficiencies. Good circulation of the water in the boiler is another factor which requires attention in many cases. Finally, as the production of wet steam is a common fault of most boiler installations unprovided with superheaters and leads to great heat losses by condensation in steam pipes and engine cylinders, the more general use of superheaters is recommended. Jacketing for steam cylinders is closely allied with this subject of superheat and the prevention of heat loss by condensation before the steam has performed its work in the cylinder.

LETTERS ON PRACTICAL SUBJECTS

MINIATURE STEAM ENGINE AND ELECTRIC MOTOR.

The tiny electric motor and steam engine illustrated herewith, the picture being a trifle large than actual size, are interesting examples of miniature mechanical workmanship. They were made by the writer, and have been exhibited at international exhibitions. The little steam engine is made of 14-carat gold and Stubbs steel. It is put together with screws and not soft-soldered. It has a slide valve and is less than 3/8 in. long over all and 3/16 in. wide. The height is 1/8 in., except the flywheel, which is 5/32 in. in diameter. The other dimensions are of interest. The intake and exhaust pipes are less than 1/32 in. in outside diameter. The bore of the cylinder is 0.06 in., the stroke being 0.07 in. The crankshaft, with center throw, was turned from a piece of Stubbs steel, and the main bearings are 0.0175 in. in diameter. The slide valve moves 0.0175 in. by an eccentric on the main shaft. The complete engine weighs 6 grains and slips easily into a 0.22-calibre short cartridge shell. It will run with compressed air or steam. The pipe supplying the steam or air is shown at *A* connected to the smaller pipe *B*, the latter being a spectacle-frame wire bored out. Operated on a single cell of dry battery the little motor runs with a slight humming noise. It stands on a hard-rubber base less than 5/16 in. in diameter and is of about the same height. It has a "dumb-bell" armature wound with No. 40 silk-covered copper wire, and the field core is wound with 11 in. of wire of the same size. The binding posts are of gold, perfect in detail and 1/64 in. in diameter. In making this electrical trinket the commutator demanded most exacting work. It consists of two copper segments properly insulated and yet the outside diameter is less than 1/32 in.



Miniature Steam Engine and Electric Motor (Very Slightly Enlarged).

Waterloo, Ia. S. A. ASQUITH.

PROTECTING GAS PIPES AGAINST ELECTROLYSIS.

After a number of experiments in the effort to insulate and protect its service-pipe runs against electrolysis the Laclede Gas Company, of St. Louis, is now covering its wrought-iron piping with layers of pitch and paper, which seem successful in solving a vexatious problem. The wrought-iron pipe, in sizes from 2 in. to 3/4 in., is first coated with a tar-and-pitch mixture, heated and thinned sufficiently to flow easily, and onto this a 4-in. paper ribbon is wrapped spirally, its edges overlapping. This paper covering is then tar-painted and again wrapped with paper, the process being repeated until four successive coats of tar and paper have been applied. Pieces of pipe thus insulated have been placed in the ground under the most distinctive conditions of electrolysis, along with other lengths not so treated. After being taken up at the end of two years the unprotected pipes were badly pitted and almost completely consumed, while the insulated piping was virtually in the same condition as when laid. Although no test has yet been made carrying the insulated pipe to total disintegration, it is believed that pipe so treated will have its life at least doubled, and if this is true an expenditure for insulation equal to that of the cost of the bare pipe is justified. Only service runs are being so treated, the cast-iron mains being less subject to corrosion and electrolysis than the service pipes. The tar and paper coating is very hard when cooled, and the pipe lengths need be handled with no more care than bare pipe.

Applying Paper to Tarred Pipe.

East St. Louis, Ill. J. L. FITZHUGH.

COMBUSTION RECORDER ON NATURAL-GAS-BURNING PLANT.

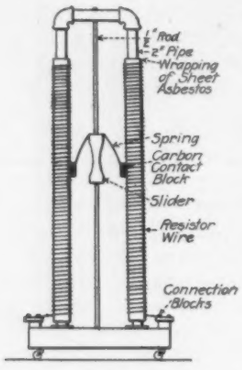
The steam-plant engineer familiar with coal as a fuel who attempts to draw conclusions from his old friend, the carbon-dioxide recorder, applied to a flue conveying away the products of natural-gas combustion will probably suffer several surprises when he examines such an analysis for complete combustion. After setting his burners to give their best bunsen flames and with a cloudless sky unsullied by his chimneys he may congratulate himself that he is accomplishing perfect combustion of the fuel gas. Turning, then, to his recorder analysis, however, he will perhaps find some such reading, in percentage volume, as follows: CO_2, 4.4; oxygen, 11.2; CO, 0; stack temperature, 355 deg. Fahr. The preceding was an analysis which plainly worried one plant operator who had been accustomed to relying on his recorder for accurate coal-combustion data. Seeking enlightenment on the subject, he found that natural gas is chiefly composed of methane, CH_4. This at once suggested that the principal product of burning the natural gas might be expected to be H_2O, or water vapor, exceeding by far the carbonic gas produced. Having no means to determine the amount of water vapor present in the stack, a chemical friend undertook to work out the index of relation between the H_2O and CO_2 produced and found that the conditions of best combustion of the 966-heat-units gas used were being fulfilled with 11.6 per cent by volume of CO_2 passing up the chimney. Although the plant records indicate an efficiency of 1 kw-hour produced for each 40 cu. ft. of gas burned under the boilers, the troubled engineer has not yet been able to boost his actual CO_2 content up to the figure theoretically attained by simple chemical reasoning.

Pittsburgh, Pa. JOHN L. SAND.

A HANDY PORTABLE RHEOSTAT.

A handy pipe-frame wire-wound rheostat capable of very finely graduated adjustments and useful for many purposes, such as loading machines, discharging batteries, etc., is shown in the accompanying sketch. The frame is made up of lengths of 2-in. iron pipe connected by the cross-piece and elbows, and firmly mounted on a wooden platform, which may be equipped with rollers to make the apparatus portable. Around the vertical pipes sheet asbestos is wrapped and on this is wound the resistor wire, in a single layer, care being taken to leave a slight air space between adjacent turns of the wire. In the cross-piece, half-way between the elbows, a hole is drilled to receive the vertical rod on which slides the movable contact, the lower end of the rod being firmly fixed in the platform. On this smoothed rod a rider is arranged to slide. This rider carries a pair of brass spring pieces ending in carbon blocks which bear flatly on the turns of the rheostat wire. The lower ends of the resistor coils are connected to binding posts on the platform base. When the slider is at the top of the rod all of the resistor is in circuit, and when dropped to the bottom the resistor is cut out. The friction and pressure of the springs on the coils hold the slider in position at any point desired. As the carbon contact blocks bridge several turns of the wire there is no sparking during the movement of the slider from one point to another. The vertical position of the resistor

coils assists in dissipating the heat rapidly by a sort of chimney action and the margin of space around the bottom of the platform prevents the hot rheostat from being brought into contact with anything which could be damaged. Aside from these points the rheostat is inexpensive to build, and in serviceability will many times repay its cost. The resistor wire should be



A Handy Portable Rheostat.

wound in opposite directions around each leg of the rheostat so as not to magnetize the pipe by the heavy currents flowing.

Cleveland, Ohio. A. S. Johnson.

FOUNDATIONS FOR ELECTRICAL MACHINERY.

In some cases after a machine is aligned on a foundation preparatory to being grouted in, the space between the foundation bolts and their casings is filled with grout. Bolts should never be thus "grouted in" in pocketed foundations, because the reason for pocketing is that the bolts may be removable. It is believed that where a machine is well grouted to a foundation it is not necessary to fill the casings with cement. The bolts will hold the machine down to the foundation and the grout between the bedplate of the machine and the face of the foundation will prevent lateral movement. Where wooden casings are used they should be removed from the foundation if the bolts are to be grouted in before the grout is poured. Where wooden casings are to be removed they should be tapered slightly from one end to the other so that they can be removed easily.

Many types of foundation washers are used. Three of the most common, arranged on their bolts, are shown in Fig. 1. That shown at *A* and detailed in Fig. 4 is especially designed for foundation applications. At *B* an ordinary building washer is shown. In Fig. 3 are given the dimensions and weights of

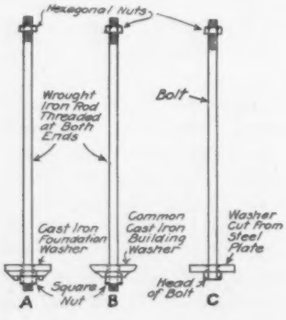


Fig. 1—Common Type of Washers.

one manufacturer's line of building washers which are approximately typical of all. Each manufacturer's line appears to differ slightly from those of others. Washers can be proportioned from the equations given in Fig. 3. Washers proportioned from the equations will differ somewhat in dimensions from those for which dimensions are tabulated. Cast-iron building washers can be used for foundation washers with safety where the bolts that carry them are to be cemented in, but it is probably better to use a stronger and larger washer, like that of Fig. 4, where casings are arranged around the bolts.

Washers like that shown at *C*, Fig. 1, can be cut from steel plate where regular cast-iron foundation-bolt washers (Fig. 4) are not available. As shown in Fig. 2, the plate washer is merely a square piece of steel plate with a hole drilled or punched through it. The length of each side of a punched washer may, for the same size of bolt, be made equal to the length of side for a cast washer, as given in Fig. 4. The thickness of the punched washer should be less than the thickness shown in Fig. 4 for cast washers, because wrought iron (mild steel) is considerably stronger than cast iron. A plate washer should be about one-half the thickness of a cast-iron one, as given in Fig. 4.

Tabulated above Fig. 4 are the dimensions of a line of cast-

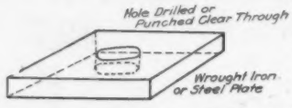
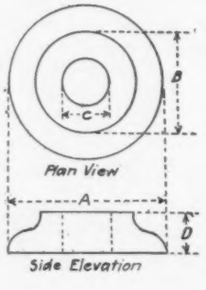


Fig. 2—Washer Made from Steel Plate.

iron foundation-bolt washers that has given very satisfactory service. The area of face of each washer is ample to maintain the pressure on the masonry when the bolt is stressed to its safe strength. The washers are thick enough so that they will not crack, even if the load is imposed on them unevenly. Small bosses on the lower face prevent a square nut on the lower end of a foundation bolt from turning. The pattern is so simple that any foundry can make good castings from it.

Pockets for foundation-bolt washers are provided, as indicated in Figs. 5 and 6, in foundations from which the bolts must be removable. Occasionally a foundation bolt is broken off at the threaded portion and it is difficult to replace the bolt unless pockets are provided. Again, it is sometimes not feasible to place the bolts at the time the foundation is being constructed, possibly because the bolts have not been received from the manufacturer of the machine, who sometimes furnishes them. In such instances pockets must be provided. A pocket is a hand hole or chamber from the side of a foundation (or, in some cases, from a tunnel through a large foundation) extending to a point somewhat beyond and directly under



Dia. of Bolt = d	A.	B.	C.	D.	Wgt. in Lbs.
½	2 5/8	1 3/4	7/16	5/8	½
5/8	3	1 7/8	11/16	3/4	¾
¾	3 ¼	2 1/8	11/16	7/8	1 ¼
7/8	3 ¾	2 ½	11/16	7/8	1 ½
1	4	2 ¾	1 1/16	1 1/8	2 ½
1 1/8	4 ¾	2 ¾	1 3/16	1 1/8	3
1 ¼	6	3	1 3/16	1 3/8	5 ¾
1 ½	6 ¼	3 ¼	1 5/16	1 ½	6
1 ¾	7 ¼	3 ¾	1 7/8	1 ¾	9 ½
2	8 ¼	4 ¼	2 1/8	2	17 ¾
2 ¼	9 ¼	4 ¾	2 3/8	2 ¼	20
2 ½	10 ¼	5 ¼	2 5/8	2 ½	27 ¼
2 ¾	11 ¼	5 ¾	2 7/8	2 ¾	36
3	12 ¼	6 ¼	3 1/8	3	46

For sizes not given in table the dimensions given by the following equations may be used.

Diameter of bolt = d

$A = 4d + 1/4$ in.

$B = 2d + 1/4$ in.

$C = d + 3/8$ in.

$D = d$

Fig. 3—Dimensions of Round Cast-Iron Washers.

the lower end of a foundation bolt. The pocket is only large enough so that a foundation-bolt washer can be inserted and so that the nut on the bolt can be turned on or off.

Pockets in stone or brick masonry foundations are readily constructed from stone or brick. The roof of each pocket consists of a slab of stone with a hole for the bolt drilled

through it. Forms of wood around which the concrete is tamped are usually employed for the formation of pockets in concrete foundations. Figs. 7, 8 and 9 show some types of

DIMENSIONS OF CAST-IRON FOUNDATION-BOLT WASHERS.

Dia. of Bolt.	Wgt. of W'sher	A.	B.	C.	D.	E.	F.	G.	H.	I.	J.
⅞″	8 lb.	6	3½	1⅛	1⅜	½	⅜	⅜	½	⅜	½
1 ″	15 "	8	4¼	1⅜	1¾	½	½	⅜	⅝	⅜	½
1¼″	30 "	10	4½	1⅜	2⅛	⅝	¾	½	¾	¾	½
1½″	45 "	12	5½	1⅞	2½	¾	⅞	½	⅞	⅝	½
1¾″	60 "	14	5½	2⅛	2⅞	1	1	⅝	1	½	½
2 ″	100 "	16	6	2⅜	3¼	1⅛	1	⅝	1⅛	⅞	½
2¼″	135 "	18	7	2⅝	3⅝	1¼	1⅛	¾	1¼	¾	½
2½″	154 "	20	9	2⅞	4	1¼	1⅛	1	1	1	½

pocket forms. In Fig. 7 the bolt casing is of wood and the pocket form is a box without one end or bottom. In building the foundation in which this arrangement was used the footing course of the foundation was first placed and then the form

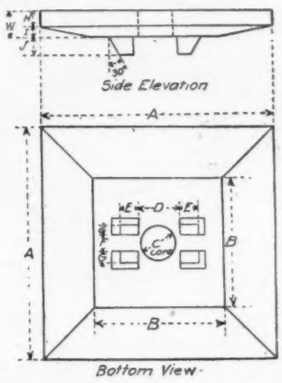


Fig. 4—Dimensions of Flat-Foundation Bolt Washers.

for the upper portion of the foundation was located and erected on the footing. The position that each foundation bolt should occupy was determined and supports for the casings (see Fig. 7) were arranged accordingly. The piece of board forming the top of the pocket form was cut to dimensions, taken from the foundation drawing, and nailed in correct position to the bottom end of the casing. The three wooden pieces constituting the sides and one end of the form were assembled and placed in the location that they should occupy under the casing and the top piece of the pocket form supported by it. Then the casing was slid up out of the way and the pocket form was filled with sand. Enough concrete was thrown around the outside of it to prevent its shifting or spreading. The top board of the form, with the casing attached to it, was then brought down into position and nailed to the three sides already in place. The pocket forms for the other bolts were similarly prepared and the foundation was poured. When the form was removed the sand poured out of the pockets and the boards composing the pocket form were pried out with a bar. Sand within pocket forms prevents them from collapsing because of the weight of concrete above them or because of heavy tamping.

Sometimes a slab of stone is used, as shown in Fig. 8, to form the back of a pocket and the sides of the form are supported by sand on the inside and a few shovelfuls of concrete on the outside. After the cavity formed by the side pieces and the back stone has been filled with sand the top board of the form, which supports the casing, is nailed to the side pieces. When the foundation has set the boards of the pocket form are pried out and the slab of stone remains. The casing shown in Fig. 8 is a piece of wrought-iron pipe and would have to be held at the top of the foundation form by a templet or by a support like that shown in Fig. 7. Where the foundation bolts are available or where temporary bolts, which can be of smaller diameter than the foundation bolts, can be secured the pocket-form arrangement of Fig. 9 is convenient. The casing (Fig. 9) is cut to a length exactly the distance between the top of the foundation and the roof of the pocket. The top of the foundation bolt is located accurately in the foundation form by a templet. The casing is arranged concentrically with the bolt by one of the methods previously shown and is clamped between the bottom face of the templet and a board which forms the top of the pocket form. A slab of stone constitutes the back of the pocket. The boards composing the sides of the pocket form (Fig. 9) are prevented from collapsing by another board nailed between them at the bottom and by nails driven through the top board and into them. It is not practicable to use sand in a pocket form with the arrangement of Fig. 9. It should be noted that with this arrangement the templet locates the casings and the positions of the pockets and that the elevation of the tops of the pocket forms is determined by the length of the casings. If the templet is laid out accurately and the casings cut to correct length the pocket forms, almost automatically, locate themselves both laterally and vertically. There is little chance for error and only few measurements have to be made by the concrete men.

The sides and back of a pocket are sometimes built with bricks, as illustrated in Fig. 10. Through this method practically all form work is avoided. A piece of board must be used as a form for the roof of the pocket. It can be supported by a bolt, as shown in Fig. 9. In building this type of pocket, the bolt, casing and the board constituting the top of the form are first suspended from the templet as shown. The brickwork sides and back are then built around the edges of the board. The sides are built first and braced inside with temporary bricks or with pieces of board. Then the back is built. Assume now that a foundation has been erected, that the foundation bolts are accurately located in it and that an electrical machine is to be installed on it. The machine is transported to the foundation and arranged on it with the foundation bolts projecting through the corresponding holes in the bedplate of the machine. The bedplate is not allowed to rest directly on the foundation, but is held about 1 in. above it with wooden blocking or iron wedges, as indicated in Fig. 11. This 1-in. space between the foundation and the bedplate is ultimately filled (see Figs. 11 and 12) with grout, which is a mixture of, say, two parts sand and one part cement. Grouting is necessary to insure that the bedplate will rest firmly on the foundation and to provide for any inequalities between the top surface of the foundation and the bottom surface of the bedplate. Before the grout is poured the machine is carefully adjusted to the right elevation and leveled by manipulating the blocking between the bedplate and the foundation. If the foundation bolts are set in casings slight lateral adjustments can be made. Grouting should be provided for in determining

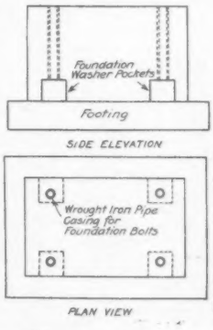


Fig. 5.—Pocket in Foundation.

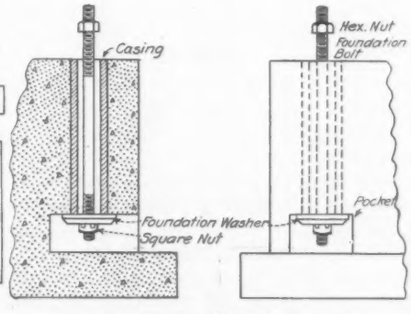


Fig. 6—Section and Side Elevation of Pocket in Concrete Foundations.

the lengths of foundation bolts, and it should also be allowed for in the elevation measurements on the foundation erection drawings.

After the machine has been leveled, aligned and adjusted to elevation dams to impound the grout are constructed entirely

around the bedplate, as indicated to the left of Fig. 11. If the volume to be filled with grout is not great the entire space under the bedplate is filled with it, as shown in Fig. 11. Dams are built of pieces of plank and are held in position with bricks, stones and clay or mortar.

The grout is mixed to the consistency of thick cream. It is

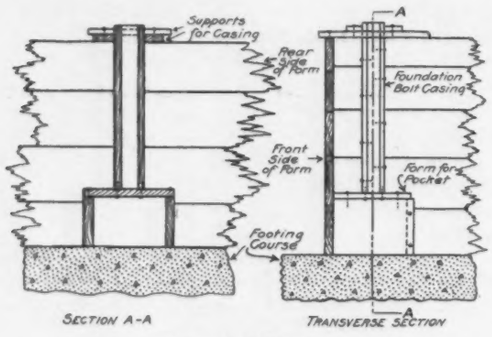


Fig. 7—Forms for Washer Pocket.

poured into the inclosure and permitted to flow and fill the area under the bedplate. It should be agitated through any openings in the bedplate while it is flowing so that it will flow uniformly and fill all cavities. If it is desired to have the space between foundation bolts and their casings fill with grout the orifices at the tops of the casings are left open and the grout as it enters the casings is churned with a piece of wire or a stick. These openings at the tops of the casings can be plugged with blocks and paper wads if the casings are not to be filled.

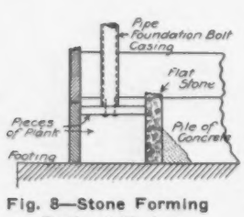


Fig. 8—Stone Forming Back of Pocket.

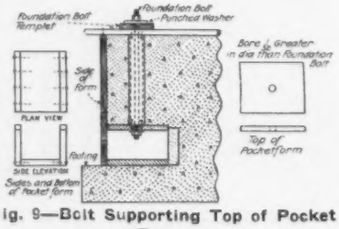


Fig. 9—Bolt Supporting Top of Pocket Form.

After the grout has stiffened somewhat the dams are removed and the grout is neatly cut away from the bedplate, as shown at the right-hand end of the bedplate of Fig. 11.

Plaster of paris has been recommended for grouting where it is necessary that a material be used that will set quickly. Mr. J. F. Hobart claims that plaster mixed with one-half of its weight of water will sustain a load of 500 lb. per square inch after setting one hour; that at twenty-four hours its crushing strength exceeds 1000 lb. per square inch, and that after twenty-four hours of setting it exceeds 2300 lb. per square inch. The weight of water used for mixing should exceed one-half the weight of the plaster. If less water is used the mixture will not pour easily. Plaster grouting must be mixed and poured quickly and should be prepared in small batches, as it sets very rapidly. Objections to plaster are that it absorbs moisture and oil readily and that it will not withstand the action of acids to the same extent as cement.

Some manufacturers of electrical machinery mount their medium-sized and small generators on two slide rails like those shown in Fig. 12, *B*, instead of on a self-contained bedplate, as

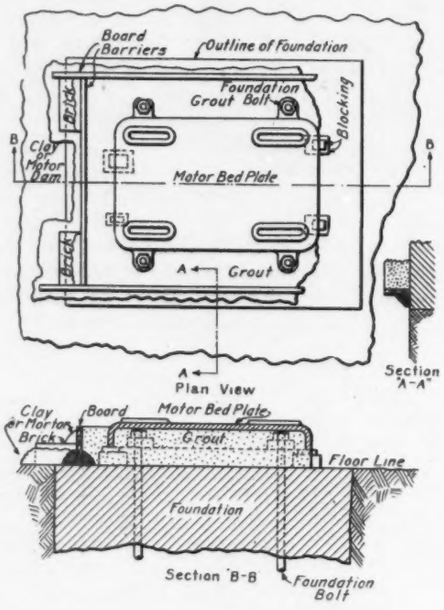


Fig. 11—Motor Bedplate Mounting.

indicated at *A*. Slide rails should be avoided. They usually require more foundation bolts than do bedplates (there are eight bolts required at *B* as against four at *A*) and it is much more difficult to level, adjust and align two slide rails than it is one bedplate. An inspection of Fig. 12 will make evident the truth of these statements.

It is specified in the National Electrical Code that generators and motors operating at pressures in excess of 550 volts must have their base frames permanently and effectively grounded and that when operating at pressures of 550 volts or less they should be thoroughly insulated from the ground wherever feasible. Wooden base frames are recommended for insulation. Where frame insulation is impracticable it is specified that "the inspection department having jurisdiction may, in writing, permit its omission, in which case the frame must be permanently and effectively grounded." Electrical machines carried on masonry foundations are seldom insulated from the ground. Wooden stringers inserted for insulating purposes between a machine and a foundation would provide a yielding support which under severe service would soon permit a machine to throw itself from alignment. In general, authorization having been secured, the frames of all electrical machines mounted on foundations should be grounded.

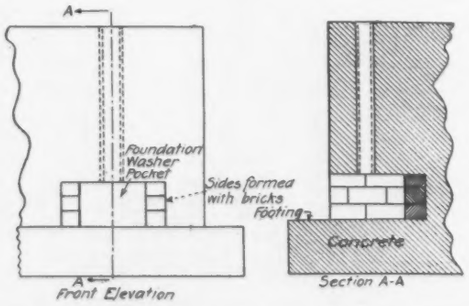


Fig. 10—Pocket Made with Brick.

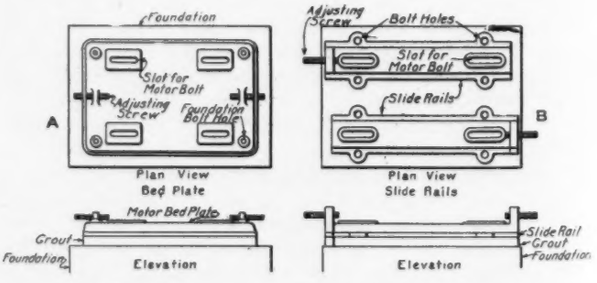


Fig. 12—Standard Mountings of Electrical Machinery.

Pittsburgh, Pa. Bruce H. Page.

QUESTIONS AND ANSWERS

Why is it that a tungsten lamp consumes so much more current when first switched on than it does a minute after? F. C. M.

The resistance of a tungsten lamp is less when cold than when the filament has been heated. Therefore more current is permitted to flow at the instant of starting. The resistance increases after the lamp has been burning a moment and then remains stable.

Is it possible to utilize the cooling water from transformers for boiler-feed purposes? If not what are the objections to its use? D. B.

Transformer cooling water has often been employed for boiler-feed purposes and the practice is commendable, especially where city water must be used and is sold on a meter basis. There is no reason why a transformer cannot be employed as an auxiliary feed-water heater.

What is the relative output of a double-current generator compared with a direct-current generator? E. M. N.

If a certain number of taps are placed along the armature windings of a direct-current generator, and these taps are connected to proper collector rings, alternating current can be taken from the collector rings at the same time that direct current is taken from the commutator. A machine operated in this way becomes a double-current generator. With equal outputs at the direct-current and alternating-current ends the machine could have the following relative permissible outputs, the output as a direct-current generator being considered as unity: At 100 per cent power-factor the permissible output with two rings would be 0.95; with three rings, 1.02; with four rings, 1.05, and with six rings, 1.07. When the power-factor on the alternating-current side is less than 100 per cent the permissible total output is reduced, the value for 90 per cent power-factor being as follows: Two rings, 0.89; three rings, 0.99; four rings, 1.02, and six rings, 1.04.

Is it possible to take a half-way tap from the secondary of one transformer in a three-phase delta-to-delta-connected 2200-to-220-volt distribution system, and use this wire as a third, or neutral, wire in a 110-volt lighting system? Could all the lamps be placed on one phase of such a system by using a larger transformer, or should the load be evenly divided between the three transformers, using a neutral tap on each of the secondaries? Are there any objections to grounding the three middle taps through spark gaps in groups or singly? Where should the voltage regulators be placed in such a system? B. E.

So far as the lighting load is concerned the three-wire arrangement suggested will operate satisfactorily. However, the load on the three-phase system would be unbalanced and the voltage relations would be distorted. If the lighting load forms only a small part of the total load on the system fair results can be obtained by placing all of the lamps on one transformer of properly increased size and regulating the voltage with reference to only this one transformer, the voltage of the remaining transformers being allowed to take care of itself. In this case the motors would take the major portion of their load from the lightly loaded phases. If the lighting load forms a large part of the total load on the system it would be better to divide it equally between the three phases, in which event the three-wire arrangement could be used on each of the three phases. However, the most satisfactory arrangement involves the use of separate circuits for the motors and lamps. The lightning arrester spark-gaps should not be placed in a common group, but should be widely separated.

Will you kindly give values that are assignable to the various types of arc lamps, that is, the mean spherical candle-power, power consumption and the specific consumption in watts per candle-power? D. L.

The performances of standard open and inclosed-arc lamps using carbon electrodes are as follows: A 9.6-amp direct-current open-arc lamp fitted with a clear globe and having an electrode life of fourteen hours consumed 461 watts and gave a mean spherical candle-power of 389, or showed a specific consumption of 1.2 watts. A similar lamp fitted with flat carbon electrodes having a life of seventy-five hours showed a power consumption of 490 watts and gave 240 mean spherical candle-power, or a specific consumption of 2 watts. A 5.25-amp multiple direct-current inclosed arc having an electrode life of 125 hours and consuming 610 watts gave 163 mean spherical candle-power with a clear inner and opal outer globe, 220 mean spherical candle-power with clear inner and outer globes, and 115 mean spherical candle-power with opal inner and outer globes, or specific consumptions of 3.7 watts, 2.8 watts and 5.3 watts respectively. A 3.5-amp direct-current multiple inclosed carbon-arc lamp having an electrode life of 125 hours and fitted with various inner and outer globes showed a power consumption ranging from 387 watts to 393 watts and yielded from 63 to 120 mean spherical candle-power. The lowest specific consumption of six tests was 3 watts and the highest 6.25 watts per mean spherical candle-power. A 6.6-amp direct-current series inclosed-arc lamp fitted with opal inner globe alone showed a power consumption of 565 watts with 307 mean spherical candle-power, and when fitted with a clear inner globe alone a power consumption of 565 watts with 414 mean spherical candle-power, or specific consumptions of 1.4 watts and 1.8 watts respectively, the electrode life being 120 hours. Tests on four 6.6-amp alternating-current series inclosed-arc lamps consuming 502 watts gave mean spherical candle-powers ranging from 155 to 216 and specific consumptions of from 3.2 watts to 2.3 watts. The power-factor of the lamps was 82 per cent. A 7-amp alternating-current multiple inclosed-arc lamp having an electrode life of seventy-five hours and a power-factor of 70 per cent showed with a clear inner globe alone a power consumption of 530 watts and gave 178 mean spherical candle-power, or a specific consumption of 3 watts. The same lamp fitted with an opal inner globe gave 133 mean spherical candle-power, or a specific consumption of 4 watts. An intensive carbon-arc lamp having an electrode life of twenty-five hours and fitted with an opal globe, the lamp being rated at 5.5 amp on multiple circuits, showed a power consumption of 650 watts and gave 333 mean spherical candle-power, or a specific consumption of 1.9 watts. A 4-amp magnetite and metallic-flame series-arc lamp having an electrode life of 175 hours and fitted with a clear globe had a power consumption of 304 watts and gave 273 mean spherical candle-power, or a specific consumption of 1.1 watts. A 6.6-amp magnetite series-arc lamp fitted with an opal globe consumed 482 watts and gave a mean spherical candle-power of 360, or a specific consumption of 1.3 watts. Direct-current flaming-arc lamps connected two in series with an electrode life of approximately seventeen hours consumed from 405 watts to 667 watts and yielded candle-powers ranging from 638 to 1311, the specific consumption ranging from 0.94 watt to 0.47 watt per mean spherical candle-power. Alternating-current flame-arc lamps having power-factors ranging from 88 per cent to 91 per cent showed power consumptions ranging from 500 watts to 640 watts. A 12-amp lamp fitted with opal globe and operating two in series when fitted with electrodes yielding yellow, white and pearl-white light respectively showed power consumptions of 630 watts, 640 watts and 616 watts respectively, the mean spherical candle-power being 965, 470 and 302. The specific consumption of the lamps in the order given was 0.65 watt, 1.3 watts and 2 watts. A 6.6-amp multiple regenerative flaming-arc lamp had a power consumption of 449 watts and yielded 775 mean spherical candle-power, or a specific consumption of 0.58 watt, the life of the electrodes being seventy hours. It is interesting to note in this connection that the specific consumption of the tungsten-filament incandescent lamp is approximately 1.3 watts per mean horizontal candle-power. In order to compare the incandescent lamp with an arc lamp whose performance is given in mean spherical candle-power it is necessary to multiply the value of the mean horizontal candle-power of the incandescent lamp by its spherical reduction factor. The latter depends on the type and characteristics of the lamp used.

Central Station
Management, Policies and Commercial Methods

SAVING IN COST OF ICE DELIVERY.

A Southern combination ice-electric plant which formerly hired wagons to do its ice delivery at $2.50 per day for driver, team and wagon last year replaced three such wagons with one gasoline automobile truck, which costs $5 a day for operation, including the wages of driver and helper (both of whom deliver ice) and also $1 a day for gasoline. The automobile-delivery wagon cost $1,000 and about $100 a year is spent in keeping it in repair. Though nominally a 1000-lb. wagon, the car usually leaves the station with five 300-lb. blocks of ice aboard, its load decreasing, of course, as it progresses on its rounds. The greatest time-saving effected by the automobile occurs in getting to and from its delivery route, enabling several trips a day to be made where a wagon could make only one.

FLOODED-AMMONIA SYSTEM WITH FORE COOLING.

A gain in efficiency and output of at least 25 per cent is said to result from the use of an improved flooded-ammonia system which is being employed in a number of combination ice and electric plants headed by Mr. C. W. Dawley, of McAlester, Okla. The improvement is the invention of Mr. Mayhew, chief refrigerating engineer of this chain of plants in Oklahoma, Arkansas and Texas. Besides the advantages of flooded operation due to higher contact efficiency in the heat exchange at the freezing coils, whatever anhydrous ammonia liquor passes through the coils unevaporated is trapped back to a fore-cooling tank, reducing the temperature of the water almost to the freezing point before it enters the cans. In this way a great saving of heat is effected, resulting, in practical operation, in increasing the output from 20 per cent to 25 per cent.

COMBINATION ICE-MAKING PROFITS IN TOWN OF 5000.

The electric-light business in a Southern town under 5000 population was operated for several years at a loss until an opportunity came for putting in an ice plant in combination. The 25-ton compression plant, together with a 20-ton tank, cost $20,000 to install, including additional buildings, one boiler and a 100-ton cold-storage room. The ice-plant operating expense is made up as follows: Fuel, $200; salaries, office, supplies, etc., $200; water, $100; total, $500 a month. The ice plant is operated eight months a year on account of the long season, and ice is sold wholesale for $6.50 a ton and 50 cents per 100 lb. at the platform. The annual income from this plant has been $10,000 for the ice department alone, although the electric plant still barely pays expenses.

ICE BUSINESS MAKES ELECTRIC SERVICE POSSIBLE.

St. James, Mo., with 2000 population, is an example of a small community in which electric service is made possible by the operation of an ice plant in combination. In this case, as seems not infrequent in ice-electric plants, the ice equipment is the principal revenue producer, while the electrical business is done virtually at a loss. The plant comprises 75 kw in electrical equipment and a twenty-ton steam-driven compression plant, sharing a common set of boilers. The plant has received the best possible construction, inside and out, and cost $27,000, of which $19,000 is invested in the ice machinery. Being the only artificial ice plant in its neighborhood, ice is shipped to surrounding towns, justifying the twenty-ton equipment installed, which would ordinarily be excessive for a town of 2000 population. The 200 electrical customers benefit from this ice production by getting night electrical service, the losses during the establishment of the electrical business being recouped from the ice plant.

COMBINATION-PLANT INVESTMENT AND INCOME IN OKLAHOMA.

A combination ice-electric plant in a growing town of 4000 population in northern Oklahoma has a 12-ton ammonia compressor steam-driven by a Corliss-gear engine. The ice-making equipment, including compressing machinery, tank, cooling tower, delivery wagons and the proportional share of the boiler capacity, represents an investment of $17,000. Ice is sold locally at 20 cents to 50 cents per 100 lb. depending on the quantity used, and some surplus is disposed of in wholesale car lots at $3 to $4 a ton. The average price received for all ice sold is 37 cents per 100 lb.

Last year the income from the ice part of the business was $5,000 after subtracting the cost of labor, gas, fuel and other operating charges, but making no allowance for depreciation. Assigning 5 per cent for such depreciation, the net income is thus seen to reach about 23 per cent on the original amount invested.

The profits made in the ice department of the business are in marked contrast to the results produced by the electrical department, the annual gross income of which is approximately the same as that from the ice business. On account of the far heavier investment and operating costs of the electrical end, however, such profits as are found remaining on the books at the end of a year's run are practically eaten up if due allowance be made for proper depreciation losses. This unbalanced condition of ice and electric incomes, always in the favor of the ice plant, appears common in small combination plants and deserves investigation from other managers with purely electric stations who find their electric income alone either satisfactory or insufficient.

PRIME MOVER FOR ICE PLANT AND ELECTRIC DAY LOAD.

The combination ice-electric plant of the Atoka (Okla.) Ice & Power Company is unusual in having a combination prime mover for its electric generator and ammonia compressor. As a result during the summer time, when the ice machine is in continuous use, twenty-four-hour electric service is available for driving fans and operating electric irons. From the day business which it has been possible to establish in this way, Mr. L. B. Griffing, manager of the company, now feels justified in instituting twenty-four-hour service throughout the year, and does not contemplate shutting down again after starting his day service May 1.

Although this combination arrangement of compressor and electric engine effects a saving by requiring the minimum of apparatus investment, some losses are involved in compromising the high speed required by the generator with the low speed of the compressor unit, besides the other objections of inflexibility of the set. The installation comprises a 125-hp Corliss engine, running at 70 r.p.m. and driving a 25-ton horizontal

Wolff-Linde ammonia compressor. From the 10-ft. flywheel on the shaft a belt is carried to the 75-kw, 2300-volt, 60-cycle, three-phase alternator running at 514 r.p.m.

Heretofore, from Sept. 1 to April 30, the ammonia cylinder has been operated idle, the engine being run twelve hours nightly to drive the alternator only. From May 1, however, the output of the ice machine requires twenty-four-hour operation of the engine, and this incidentally furnishes day service for electric fans and motors at a time of the year when they are most welcome. For meeting the peak load, with the compressor in service, an auxiliary generator driven by a 65-hp engine is also arranged to be operated from 8 p. m. to 10 p. m. As a result of the day load now established by summer operation, the plant is to furnish twenty-four-hour service continuously.

BUTCHERS' SAVINGS WITH MECHANICAL REFRIGERATION.

By replacing ice cooling of cold-boxes with mechanical refrigeration using central-station motor service, butchers, florists, confectioners and others are usually able to show a saving over their former ice bills. Especially is this true in the Southern States having protracted heated seasons, where natural or artificial ice is correspondingly scarce and costly.

For preserving foodstuffs in any climate, however, mechanical refrigeration has the important advantage of producing a "dry" cold which can be carried to any low temperature desired. With ice, of course, only a humid cold, not below 32 deg. to 35 deg., can be obtained in the ice-box, but with refrigeration sub-freezing temperatures are easily reached and the dirt and annoyance of ice delivery are all avoided.

Alley Brothers & Company, butchers at Muskogee, Okla., who do their own slaughtering, last year installed a 7½-ton ammonia-compressor refrigerating machine driven by a 15-hp motor. This equipment maintains continuously a temperature 27 deg to 36 deg. in four large ice-boxes of the following dimensions: One box 14 ft. x 16 ft. x 11 ft., one 6 ft. x 8 ft. x 11 ft., and two 3 ft. x 6 ft. x 11 ft. These boxes are charged with warm, freshly killed meat, so that the load on the refrigerating plant is heavier than it would be if used only to preserve meat already chilled or frozen. The average consumption of the outfit has averaged about 1100 kw-hours per month, the same motor being used to drive, through shafting, a meat chopper, sausage machine, 200-lb. lard agitator and a 12-in. grindstone. The Alley company is quoted by Mr. Norman B. Hickox, contract agent of the Muskogee Gas & Electric Company, which supplies the service, as declaring that the cost of this mechanical refrigeration is from one-half to one-third that formerly paid for equivalent ice, being about the same for refrigerating the four boxes as for icing one 6-ft. x 8-ft. x 11-ft. box.

INVESTMENT AND INCOME FROM 25-TON COMBINATION ICE-ELECTRIC PLANT.

A certain 25-ton combination ice-electric plant in a town of 8000 population on the same line of latitude as Little Rock, Ark., represents an investment of $40,000 in the ice department of its business. The first cost was divided as follows: Buildings, $12,000; ice-making equipment, including steam-driven compressor, boiler, can tanks, etc., erected, $22,000; 75-ton ice-storage room, $3,500; delivery wagons, $2,500. The equipment is all of the best, installed by competent engineers, and the buildings are of modern concrete and steel construction, with corkboard insulation, etc.

The steam-driven compressor plant produces approximately 3 tons of ice per ton of coal, an average figure in plants of this size, despite the claims of machinery manufacturers and others. The cost of making and delivering a ton of ice in the town mentioned is about $4.50, including all plant expenses, fuel, delivery charges, overhead, etc. The plant expenses alone run about $2 per ton, of which from $0.80 to $1 is for fuel alone. Including plant labor and delivery labor, stable expenses, management, etc., the cost of placing a ton of ice in the customer's refrigerator thus reaches $4.50.

The average rate for which this ice is sold is about $6.50 per ton. Last year during a season of 150 days 4000 tons of ice were produced, quantities of from 25 tons to 35 tons being pulled on different days as required. A small quantity of ice was kept stored in the cold-storage space when possible, providing an extra supply for hot days. The cost of refrigerating this stored ice has been computed to be about ½ cent to ¾ cent per ton per day, with the ice-making machine in operation to furnish other refrigeration. Of course, were the ice machine operated solely for this purpose of "holding" the stored ice the cost would be higher per ton.

For the 4000 tons of ice frozen and delivered last year the company received $26,000 gross income. The operating expenses in producing this ice were $18,000, including fuel, labor, plant expenses, delivery expenses, management, office costs, 10 per cent depreciation on the equipment, taxes, insurance, etc. This left $8,000 net revenue, which applied on the total investment of $40,000 represents the gratifying income of 20 per cent to meet interest, profits, etc.

STEAM-DRIVEN COMPRESSOR IN AN ICE-ELECTRIC PLANT.

The main generating unit of the Okmulgee (Okla.) Ice & Light Company in its new combination ice-electric plant is a 200-kw Westinghouse horizontal, four-cylinder, gas-engine-driven, direct-connected alternator operated on natural gas, which costs 10 cents per 1000 cu. ft. This set is run twelve hours daily, from 6 p. m. to 6 a. m. A 100-kw, four-cylinder, double-tandem gas-engine unit was formerly in use for the light-load daylight service, but on account of mechanical difficulties with this engine it has been dismantled and will be replaced by a more modern type of unit. In the meantime a spare 190-hp simple Corliss-gear engine, left in the plant for emergency service, is being used for belt-driving a revolving-armature alternator in place of the dismantled small gas-engine unit. This engine set receives steam from the boilers provided for the steam-driven compressor engine, but no by-product use is made of its exhaust.

The water at Okmulgee is obtained from the city mains and is not suitable for raw-water ice-making. This precluded the installation of a gas-engine-driven compressor plant making raw-water ice without the use of evaporator apparatus. It was, therefore, decided to install steam boilers furnishing steam to a 25-ton engine-driven compressor machine. The plant installed is a 25-ton Ruemmeli-Dawley outfit, making can ice in 300-lb. blocks. The compressor engine furnishes all the distilled water required for ice making, and no provision is made for collecting the exhaust from the spare electrical engine.

The brine is circulated by a 5-hp motor-driven centrifugal pump, and the agitator propellers in the freezing tank are also run by a 5-hp motor. For operating the 10-ft. fan producing draft through the cooling tower a 15-hp motor remains to be installed.

The natural gas used at Okmulgee is from the nearby Oklahoma field. It contains approximately 900 b.t.u. per cubic foot and costs the company 10 cents per 1000 cu. ft. Last year 2643 tons of ice were made in this plant, burning under the boilers 26,538,000 cu. ft. of gas, or 9900 cu. ft. per ton of ice. The ice plant is run as needed during nine months in the year, on some days from 20 tons to 29 tons of ice being pulled. In connection with the plant is a 40-ft. x 40-ft. storage-room artificially refrigerated for holding its contents at the freezing point.

During an average twelve-hour run, producing 365 kw-hours, at a mean load of 30.4 kw, the gas meter on the large gas-

engine set has shown a consumption of 31,550 cu. ft. of gas, or about 86.5 cu. ft. per kw-hours at this partial load. Under other conditions, producing 930 kw-hours at an average 77-kw load, the engine's consumption was reduced to 33,800 cu. ft., or 35 cu. ft. per kw-hour.

INVESTMENT AND INCOME OF A SMALL ICE PLANT.

The ten-ton live-steam absorption ice plant of a Missouri combination ice-electric station cost $20,000 complete when built five years ago. This cost, which includes all charges assignable to the ice-making department of the station, is divided as follows:

Machinery, freight and erecting	$13,000
Cold-storage rooms, 100 tons capacity	3,000
Part of building used for ice making	2,000
Boiler investment chargeable to ice	1,200
Well and pump	800
Total	$20,000

The ice plant operates four months each year in its town of 3600. During nearly all these days full can capacity is pulled, while during the heated term the plant can be pushed to turn out eleven tons when needed. The ice sells at from 30 cents to 80 cents per 100 lb., averaging about $6.40 per ton. During the four summer months of 1910 20,000,000 lb. of ice was sold, providing $6,400 earnings for the season. The cost of labor and fuel for producing this ice was $3,340, to which must be added $400 fixed expenses for insurance and taxes. Subtracting 5 per cent for depreciation on the equipment, the net profit on the investment is seen to have reached $2,300, or almost 12 per cent. Coal in this region costs $3.50 a ton. The electrical equipment operated from the same 250-hp boilers comprises 140 kw total rating in engine-driven generators. The ice machine uses steam at 40 lb. pressure per square inch.

In the case of the above plant the ice cold-storage compartments have proven one of the best investments in the plant. If this equipment were to be enlarged for a greater output it would doubtless pay to extend the cold-storage rooms first, leaving the ammonia equipment of the present capacity until the station demand reaches a point where the ice machinery could be at least doubled to advantage. The presence of the cold-storage space enables ice to be frozen during slack periods and stored against the hot days. The cost of such storage capacity is much less than equivalent ice-making apparatus, and although the refrigeration required to store ice costs about 1 cent per ton per day, these charges will often be found less than the interest on the ice-machine investment. Eventually, of course, the ice apparatus will have to be enlarged, but such a move should not be undertaken until it is shown that the machine can at least be profitably doubled in capacity. Where an exhaust absorption machine is used, of course, the refrigeration of cold-storage space can be done without the expenditure of additional energy or steam, and almost without cost, making ice storage during slack months relatively inexpensive and a smaller rating of ice-making capacity sufficient.

HINTS ON MARKETING CENTRAL-STATION ICE IN SMALL TOWNS.

In perhaps no other business—at least in none with which the central station is likely to deal—are employees exposed to such temptations for "knocking down" illegitimate cash sales as in the manufacture and delivery of artificial ice. Unless the central-station manager new to the ice business considers and guards against these opportunities for loss, he is likely to be the victim of considerable petty thievery which may make no small difference in his profit-and-loss account. Take, for example, the case of a plant in a small town of 3000 to 6000 inhabitants, producing ten tons of ice per day and employing five delivery wagons. If these delivery men—for whose work often only the roughest kind of labor is available—feel disposed to add a dollar or more each to their daily wages, through unreported sales of ice to customers, the company will sustain a dead loss from its profits of $5 a day, or $150 a month. Delivery-wagon drivers are all too prone to collect such illegitimate bonuses, and the company must be on its guard to provide checks against these practices. The frequency and annoying persistency with which they occur have almost forced some managers into the disposal of their output wholesale to contracting delivery men for retailing, but when the central-station manager gives up his retail business he sacrifices a large item of profit. Ice which costs $2 a ton to make and $1 a ton to deliver can often be sold to retail customers at an average price of $6 per ton, leaving a net profit of $3 per ton. The same ice could probably be sold to a contractor delivery man for not more than $3 a ton, leaving to the manufacturer a profit of only $1 a ton on ice which costs him $2 to make. Although spared the annoyance of delivery, the ice plant thus cuts its income to one-third by adopting the wholesale plan of disposal.

To make a retail delivery business a success, however, some adequate means of checking must be applied to the wagon drivers and plant employees, so that every cake of ice manufactured is accounted for (barring allowance for shrinkage due to melting) from the time it leaves the cans until it reaches the customer's ice-box. After an experience of four years in ice making, a small Missouri central station operating a combination ice and electric plant in a town of 3500 population detected irregularities in its delivery system and installed a complete checking system, since which it is assured payment for all ice produced. This plant is now one of the most successful ice-electric stations in the country, last year returning an income of 13 per cent on its ice equipment from four months' operation, after deducting charges for interest, depreciation and taxes.

As each block of ice comes down the chute it is counted by an automatic register, and at a given hour each day an inventory is made of all ice in the storage room. The platform man is provided with a cash register on which he rings up all sales made at the plant. As each delivery wagon starts out with its load of ice the quantity taken is recorded, record also being made of the amount returned at the end of the day. The wagon driver is thus charged with all ice which he fails to return, allowance being made, of course, for the amount which has melted, according to the temperature of the weather and the size of load carried. For all ice thus taken the driver must turn in either cash or the company's regular tickets. In addition to this he must turn in receipts covering the entire amount, signed by the customer and showing that the ice has actually been delivered. No opportunity is thus afforded for the illegitimate sale of ice either at the plant or on the wagons, and the company has the assurance that it receives payment for all ice manufactured.

STEAM CONSUMPTION OF ICE-ELECTRIC PLANT.

After nine years' experience in the operation of his present combination ice and electric plant, Mr. C. E. Lahman, manager of the Vinita (Okla.) Electric Light, Ice & Power Company, has made a careful study to determine the kind of ice-making equipment best adapted under local conditions as an auxiliary to his new 250-kw electrical generating station, which is now nearing completion. The old plant comprises a 175-kw engine-driven generator and a 12-ton Corliss engine-driven ammonia compressor, both sets using steam from a common set of boilers. The plant property is also fortunate in having an 1150-ft. artesian well showing 50-lb. pressure at the surface of the ground and delivering about 500 gal. per minute of 70-deg. water to the overhead cooling tower without artificial pumping.

The new generating station will contain one 100-kw and one 250-kw alternator, each direct-driven by an equivalent simple Corliss engine, arranged to be operated condensing if desired. After study of local conditions, low-pressure absorption ice-making equipment was decided upon, utilizing at a slight back-

pressure the exhaust from the auxiliary pumps together with that from the smaller engine unit, which will be operated part of the year non-condensing. The larger set will be run condensing at all times when it is in operation. The small 100-kw engine-driven set will be useful during light-load periods to supply twenty-four-hour electrical service without running the large unit. When exhausting at about 5 lb. per square inch back pressure into the 30-ton absorption ice machine it will require about 41 lb. of steam per indicated hp-hour. Assuming an average load of 100 hp on the electrical unit, the engine will take about 98,400 lb. of steam per twenty-four hours. The steam-driven ammonia pump for the absorption plant will require about 4603 lb. per twenty-four hours, making a total of 102,643 lb. of steam needed with the absorption apparatus installed.

Were a compression plant installed under these conditions, using a good simple Corliss-gear engine-driven machine, Mr. Lahman estimates that such a 30-ton compressor alone would take 49,428 lb. of steam per twenty-four hours. The small engine-generator set could then be operated condensing at an improved efficiency, and, under these conditions, carrying an average 100-hp load as before, it would require but 74,160 lb. of steam per day. The total demand on the boilers, however, in this case would be 123,588 lb. of steam per twenty-four hours, or 20 per cent more than that with the generator engine running on back pressure.

In the case of the Vinita plant the marked advantage gained by the absorption system will be the by-product manufacture and storage of ice during the winter months at almost negligible operating expense, at the same time releasing the small generator engine during much of the year for operation condensing at the same high efficiency as were a compression plant installed. The exhaust from the ammonia pump alone, discharged into the absorption machine, will produce about 10 tons of ice per day, besides refrigerating the 1500-ton cold storage with which the plant will be provided. The small engine, as already noted, will be arranged for exhausting into the station condenser line and can be thus operated condensing during all but the hottest months of the year, when it is desired to push the ice-plant output to its limit.

The provision of so unusual an ice-storage space, with a capacity of 1500 tons, in connection with a 30-ton ice plant will make it possible to manufacture ice from the ammonia-pump exhaust alone during the winter with minimum steam consumption and at no reduction in generator efficiency, preserving this ice for the hot days of summer consumption when demand for it is greatest. In the Vinita instance, therefore, Mr. Lahman is well satisfied that he has made the proper selection of ice-making apparatus.

PREVENTING TUNGSTEN STREET-LAMP BREAKAGES IN WINDSTORMS.

Some recent experiences of the Lawrenceville (Ill.) Light & Water Company, of which Mr. Cale R. Gough is the manager, have brought that company to the practice of maintaining enough current in its series-tungsten street lighting circuit on excessively windy days to keep the lamp filaments hot and ductile to prevent breakage. This company has never until recently experienced any abnormal breakages on its tungsten street-lighting circuit, which now comprises seventy-eight 100-watt, 6.6-amp series-tungsten lamps and nine 450-watt tungsten lamps, together with six inclosed-arc lamps. During some very high windstorms in March, however, during daylight hours, six lamps were broken. These lamps are equipped with the regular filament cut-out in the base, which is supposed to be punctured by a moderate voltage when current is turned on to the circuit and a lamp filament is broken. With the six lamp filaments broken, however, the combined resistance of all of these filaments in series was too much for the 2200 volts which were applied to the circuit when an attempt was made to start the street lamps. The result was that the circuit could not be started until after most of these broken lamps were located.

As the result of his experience Mr. Gough has concluded that it is better on excessively windy days to keep the street-lighting circuit in operation with enough current to keep the lamp filaments ductile, thus accomplishing two objects; first, a reduction of the lamp breakage, and, second preventing interruption to service the following night because of inability to start the street circuit should a number of lamps become broken during the day. The cost of keeping current on the circuit during the few windy days in each year that it is advisable is small compared to the loss of revenue and reputation and cost of lamp renewals which might otherwise result. This is especially true in a station operating with gas engines, as at Lawrenceville, where the kw-hour cost of fuel is low. In such a plant the fixed and maintenance expenses are considerably more than the fuel bill, and these latter expenses are not appreciably changed by such practice.

SELLING HOT WATER FROM A HEATING SYSTEM.

A central station operating in a town of about 5000 and having an extensive hot-water heating system some two or three years ago began the practice of selling hot water to various consumers along its hot-water heating mains. For this purpose service was maintained the year around. It was claimed by the management at the time that hot-water main repairs were less by keeping the system hot in this way than when it was shut down during the summer, and that this, together with the revenue obtained from hot water sold, resulted in a net gain to the company. Subsequent events, however, have proved the fallacy of this.

After two or three seasons' operation the plant began to have serious difficulties in keeping the water in its system hot during cold weather and investigation revealed the fact that the heaters were almost completely filled with scale. This was, of course, caused by the water which was pumped into the hot-water system just before it entered the heater in order to make up for the water sold and leakage in the system. The amount of water taken out by purchasers and leaks was so great that excessive scale in the hot-water heaters resulted. Of course, softening of water introduced in the hot-water system would have prevented this result, but it would seem that the sale of hot water from a heating system of this kind should be carefully safeguarded wherever it is undertaken.

THE ELECTRIC-VEHICLE OPPORTUNITY FOR THE CENTRAL STATION.

There are 5000 builders of horse-drawn vehicles in this country. Last year $250,000,000 was spent on motor-driven conveyances, mostly pleasure cars. There are, however, 500 commercial vehicles in use to every one pleasure vehicle. The above figures afford some idea of the future which awaits the central station in the supply of off-peak energy to battery-operated vehicles.

There were eighteen electric automobiles in St. Louis in 1907, said Mr. Hermann Spoehrer, secretary and treasurer of the Union Electric Light & Power Company, of St. Louis, before the Missouri Electrical Association, April 14, in discussing the subject of the electric vehicle's significance to the central station. To-day, as a result of the Union Electric company's stimulation by inaugurating adequate electric-garage facilities, there are 500 electric machines in St. Louis, the average income from which is $8.50 per month in the case of cars stabled in private garages.

The original electric garage in connection with one of the central-station company's substations is now retained for pleasure-car purposes, being augmented by a new commercial-truck garage in the business section, as has been described in the *Electrical World*.

Experience has demonstrated that with electric trucks 85 per cent of the hauling in a city can be done successfully. A large New York concern which rents delivery wagons to merchants is now replacing its horse-drawn wagons by electrics. The large dry-goods house of Scruggs-Vandervoort-Barney in St. Louis conducted exhaustive comparative tests on gasoline and electric delivery wagons, the result of which was the complete victory of the electric machine, in spite of its being charged with 33 per cent depreciation per year. This heavy depreciation has not been nearly realized, as the cars are still in good condition after four years' use. The Anheuser-Busch brewing interests in St. Louis have a model electric garage with fifty-six electric trucks in use.

Comparing the demand, consumption and revenue of electric vehicles with other energy-consuming devices, Mr. Spoehrer presented the following table:

Type of Vehicle.	Estimated Kw-hours Annual Consumption.	Income at 4 Cents per Kw-hour.	EQUIVALENT NUMBER OF		
			500-Watt Arc, 4 Hours, 300 Days.	50-Watt Lamp, 1 Hour, 300 Days.	Flatirons, 3 Hours Daily.
5-ton	11,000	$440	17	752	144
3.5-ton	9,360	374	14	624	120
2-ton	7,440	297	11	496	95
2000-lb	5,520	220	9	368	70
1000-lb	4,560	182	7	304	58
Pleasure car	2,400	96	4	160	30

This table shows the income assured from an electric vehicle in terms of the equivalent number of lamps or irons required to consume the same quantity of energy. But with a single large customer like a vehicle the overhead costs of meter reading, accounting, billing, etc., are greatly reduced. For example, in the case of the pleasure car, instead of thirty separate customers' meters to be read, and thirty customers' bills to be made out and collected, there is only one such account to earn the same revenue. Ninety per cent of vehicle charging is done from 8 p. m. to 12 p. m., and not only does the vehicle load improve the daily load-factor, but, on account of the larger use of electric cars during the summer time, the battery-charging load is greatest at a period when other customers' consumption is least.

Mr. Spoehrer urged that central-station men acquaint themselves thoroughly with the operation and performance of electric vehicles, instead of leaving the customer to work out his own selection, which, particularly in the case of commercial cars, may prove entirely unadapted to the need. It is important that the first local power wagon in a community be carefully selected and intelligently handled, as the performance of this machine will be viewed with interest by other prospective users. The life of a battery will depend largely upon the care given it by garage men, and readings of the cell conditions should be made at frequent intervals, so that any progressive deterioration can be detected and corrected. A battery properly cared for will last two to three times as long as one getting inferior attention, such as is often accorded it in the average gasoline garage by inexperienced help.

SHOWROOMS OF PUBLIC SERVICE ELECTRIC COMPANY.

The new showrooms of the Public Service Electric Company are located on the first floor and in the basement of the Public Service Building, Broad and Bank Streets, Newark, N. J. On the main floor are located one of the offices of the publicity department, the cashier's, gas-order and electric-order departments, the electric contract agent's office, a consultation room and a fixture room. A public telephone booth and a writing desk have also been placed on this floor for the convenience of consumers. Gothic architecture has been followed throughout the building and the furnishings of the showrooms, such as lighting fixtures, signs designating the various departments, etc., conform to the Gothic period.

Heavy bronze fixtures of Gothic design with brackets to match are used to light the main-floor showroom. In one section of the first floor electricity is used for lighting; in another, gas; and in another, combination gas and electricity. One of the especially pleasing features of the showrooms is the room set apart for the practical display of high-class lighting fixtures, domes and portable lamps. The walls and counters in this room are covered with green velour and the ceiling stenciled with gold decorations. This is a very effective way to show lighting fixtures and reading lamps to their best advantage. The consultation room is inclosed by green velour curtains, having two settees upholstered with the same material. In this room a customer may in comfort discuss any matter with the salesmen. It is used, however, principally by those desirous of seeing designs and sketches of fixtures and of going over the lighting plans of their houses with the fixture salesman.

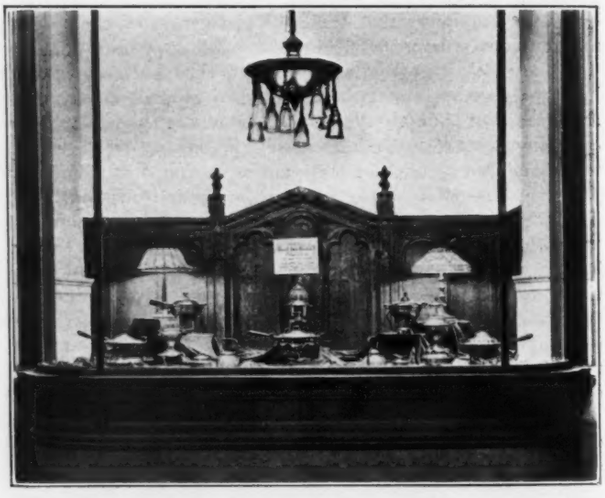


Fig. 1—Window in Broad Street, Showing Electrical Appliances.

The display on the main floor has been confined to the higher priced portable lamps, fancy silk and tapestry shades, electric floral pieces, floor standards, torchères, small electric appliances, cabinet gas ranges and water heaters. These displays are arranged in individual groups and in this way the display is more pleasing and effective.

Two large windows on Broad Street, a large one and several smaller ones on Bank Street, allow ample space for attractive window displays. Copper and nickel chafing dishes, percolators, toasters, milk warmers, hot-water cups, electric heating pads, etc., are shown in groups in glass cases. Decorative silk shades and electric floral effects are also displayed in a similar manner. The torchères and piano lamps are placed in various parts of the showroom, giving individuality to the different pieces and adding to the decorative effect of the room as well. Electric and gas reading lamps are arranged in groups on tables placed in different parts of the showroom. In the electric contract department fixtures are placed for the demonstration of tungsten lamps and the various shades and accessories recommended to be used with them.

The first floor and basement showrooms are connected by a broad marble staircase, at the head of which has been placed a very ornamental sign. Here there are a number of complete exhibits, viz.: the electric kitchen, the gas kitchen, the gas and electric laundry, the power, gas and electric industrial-appliance exhibit, the lumichromoscope, the color booths, and the refrigerating and ice-making plant. The electric kitchen is fully

equipped with all electric cooking appliances such as a range, kitchen cabinet, plate-warming closet and oven, toasters, percolators, etc. A fully equipped laundry is shown in which are placed an electric washing machine, a gas-heated, motor-driven mangle, a gas-heated clothes dryer, an instantaneous automatic water heater, a refuse incinerator, and gas and electric irons. The laundry is lighted by both electricity and gas. The power exhibit is placed opposite the kitchens and laundry. The display is arranged on two wooden platforms, and motors are connected to the various machines shown. Included are a rectifier for automobile charging, a complete woodworking and air-compressing plant, an electric hoist, a dough mixer, meat chopper, coffee mill, beer pump, an exhaust fan, etc. As all machinery shown can be operated, the exhibit is surrounded by a metal railing for the better protection of the public.

Fig. 2—Main Floor of the Public Service Building.

A domestic-size refrigerating and ice-making plant is operated daily and proves of interest to many. It is of practical use as well, furnishing ice and refrigeration when cooking is being carried on by demonstrators during the first two weeks of each month. The space underneath the sidewalk lends itself very advantageously for an industrial-appliance exhibit. In this exhibit a very representative line of blast and atmospheric furnaces and electrically heated and motor-driven small appliances used in the various lines of manufacture, trade or profession are shown and can be demonstrated, as they are all connected, ready for use. All kinds of gas or electric tailor irons, electric soldering irons, glue or wax pots, drills and motors are also to be found in this exhibit.

Fig. 3—View of Basement from Stairway.

Connected with the illuminating department a lumichromoscope is shown, which affords the public an opportunity of comparing the effects of different types of illuminants on various colors. Several styles of illuminants are shown, consisting of the carbon, Nernst and tungsten lamps, electric arc and the Moore tube, as well as four types of gas illuminants, including the Bray burner, the upright and inverted Welsbach lamps and the inverted Welsbach lamp with amber mantle. The difference of the color values of these units is seen upon ribbons, which are placed lengthwise, each ribbon running through every booth. In the rear of the basement four color booths are placed. These booths are about 4 ft. square and each booth is lighted by a 25-watt tungsten lamp. The booths are papered in white, red, green and yellow. The object, of course, is to show the absorption of light by the different wall papers. These exhibits, showing as they do the effect of illuminants on color values and the absorption of light, have proved both interesting and instructive to those who have seen them.

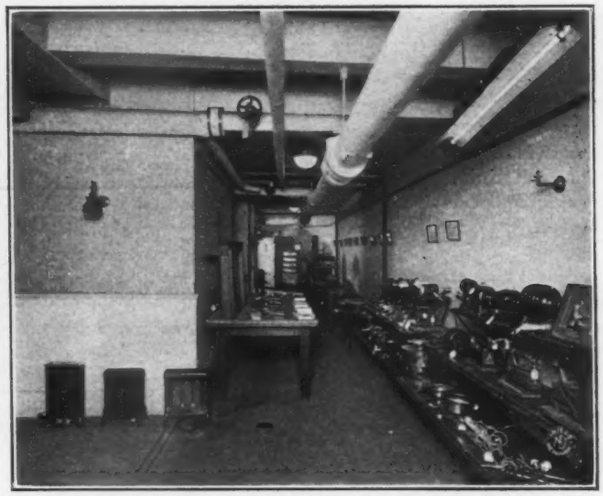


Fig. 4—Small Motors and Appliances Exhibited in Basement.

Vacuum cleaners are shown in operation and the prospective customer receives a practical demonstration of how to use one. A full assortment of electric heating stoves is also shown. Electric alabaster-ceiling units contribute to the artificial lighting of the basement. Some of the other features worthy of mention are the electric piano and the electric switchboard. The lighting fixtures used in stores and factories and for outdoor illumination have not been overlooked, as they, too, are displayed in a fitting manner in the basement.

Fig. 5—Electric Kitchen in Basement.

Wiring and Illumination

ORNAMENTAL CURB LAMPS IN IOWA.

Mr. R. M. Parker, of Ft. Dodge, Ia., presented a paper on "Ornamental Curb Illumination" at the Iowa Electrical Association convention at Davenport on April 20. He said that there are many styles of ornamental iron posts used for such installations, varying in weight from 570 lb. to 1500 lb. each. He advocated the use of a post costing about $55, carrying five lamps for large cities and three lamps for small cities. Reviewing the arguments for and against the upturned lamps, he stated that the upturned globe has a better appearance and is less likely to be broken by the retaining screws. Further, there is no chance for dirt to collect in the bottom of the globe. The objection is that ice forms around the neck of the globe in winter and prevents its being taken off for cleaning or lamp renewals. The wiring to such posts should be in lead-covered cables in conduit. The circuit should be brought to some switch box controlling a number of posts. The cost of turning on and off the lamps is about 50 cents per post per month. In working up this business the interest of the merchants should be aroused and a committee of merchants should be formed for each block, consisting of men in the block, to solicit others in the block. Another plan is for the central-station company to solicit this business block by block, but the objection is that if some merchants fail to join in the scheme there are dark places which make a ragged appearance on the street. In addition to Des Moines and Davenport there are twenty cities in Iowa having such ornamental lamp-posts, there being a total of 662 posts. The average cost per post for nineteen cities was $71 each. However, some of the larger cities have posts costing installed from $100 to $125 each. He emphasized the importance of a solid foundation for such posts. In Ft. Dodge a large concrete block is placed under each post so that it will withstand any shock it is likely to get. Mr. A. L. Dodd said that in Charles City twenty blocks in the residence district are equipped with tungsten lamps in ornamental iron posts, one lamp for a block, with underground supply through steel-covered No. 6 wire buried in parkways.

Prof. A. H. Ford suggested that the regular arc lamps be taken off the corners when curb lighting is installed so as not to spoil the effect. The globes used will make or mar the appearance of the installation. Thin opal globes showing the lamps through with a dull-red color produce a slovenly appearance. The globes should be either rough inside or be built of some smooth diffusing glass like "Alba," which will not show the lamp filament. Curb lighting makes more show-window lighting necessary. Where windows are lighted on a flat rate and the lamps turned on and off by patrolmen the same man can turn on the lamps at the posts.

AN ELECTRIC IRON INSTALLATION.

By George Travert.

A method of supporting the conducting cord of an electrically heated iron is shown in Fig. 1. The feature of the arrangement that deserves attention is the sliding support for the helical spring that carries the cord. The ordinary method of supporting the cord of an electric iron is to tie it to a spring which is attached in a permanent position and the fact that the location of the spring is fixed hampers the movements of an operator using the iron. With the scheme suggested in Fig. 1 the spring is fastened with an "S" hook (see Fig. 2) to a porcelain insulator which is arranged to slide back and forth on a wire. As the iron is pushed to and fro the porcelain insulator follows its movements and, as the spring will stretch, ironing can be done over a considerable area. It should be noted that at all times the conducting cord is supported well out of the way of the operator.

Spiral springs, like that illustrated in Figs. 1 and 2, are usually furnished by the manufacturers with all sadirons, so that the only additional material that is needed to make such an installation is the insulator, the iron wire and the turnbuckle. The iron wire, Fig. 1, is made up in a screw-eye, inserted in the wall at one end and into one eye of a small turnbuckle at the other end. Such a turnbuckle can be supplied by any first-class hardware house. The turnbuckle provides means for keeping the wire tight. The hook end of the turnbuckle engages with a screw eye inserted in the wall. It is well to arrange the iron wire somewhat to the rear of the line along which the iron will be used, as shown in Fig. 3. This is done to prevent the cord from striking the hand of the ironer.

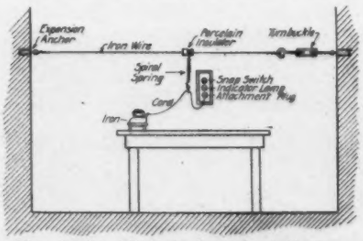


Fig. 1—An Electric-Iron Installation.

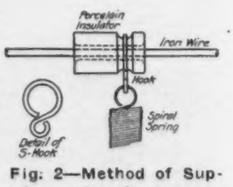


Fig. 2—Method of Supporting Spring.

A convenient method of wiring an electric iron is shown in Figs. 1 and 4. The visible components of the circuit are shown in Fig. 1 and the wiring diagram is given in Fig. 4. An incandescent lamp of small candle-power is connected across the branch circuit to the iron on the iron side of the double-pole switch. So long as the switch is closed and the iron connected to the supply source the lamp will glow and indicate the fact that the iron is "alive." This device not only tends to make the operator careful in his use of energy, but it assists in preventing the fires that are sometimes caused by an electric iron being left on a wooden ironing board while connected to a supply source.

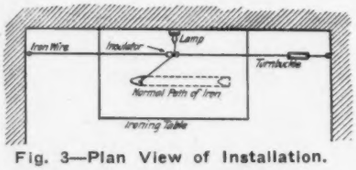
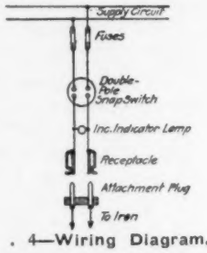


Fig. 3—Plan View of Installation.



. 4—Wiring Diagram.

ELECTRICAL EQUIPMENT OF A MODERN ENGLISH THEATER.

By J. A. Seager.

Although state aid of the drama has not up to the present been adopted in Great Britain and, therefore, the theaters of London may not possibly be of quite such a fine architectural order as those found in Berlin or Vienna, the taste of the British theater-going public is sufficiently keen to appreciate any endeavor made to provide an adequate setting to musical and dramatic entertainments, and for this reason some of the modern theaters of the British metropolis are lavish in their appointments. Particularly is this the case in the "theaters of varieties," corresponding to the American vaudeville houses. Many of these are most artistically treated and excellently equipped, and one of the most recent is the Palladium Theater of Varieties.

The electrical supply is provided by the St. James and Pall Mall Electric Light Company, Limited, on the three-wire system, 220 volts between outers. A pressure of 110 volts is employed for lighting, and 220 volts for motors, fans, etc.

Special supply mains are brought into the back of the building for the stage lighting and into the front of the building for the house lighting. A small alternative supply is also provided for the house lighting in accordance with the rules of the London County Council by the London Electric Supply Corporation.

The electrical stage equipment comprises a stage switchboard, a stage regulator and dimmers, a "special effect" switchboard, an electric stage elevator and the stage fittings, consisting of seven borders 52 ft. long, each with 250 lamps, 250 foot-lights, besides strips, bunches and proscenium side lamps, altogether over 2400 lamps in three different colors. In addition, there are eighteen spot lamps, nine on the stage and nine in the auditorium.

Fig. 1—Arrangement of Borders.

The electrical equipment in the theater comprises a large "house" switchboard, a smaller alternative switchboard, an electrically driven "Vortex" suction cleaner plant, electric fans, and, of course, all the necessary distributing fuseboards and fan-regulating boards. The electrical fittings were specially designed by Messrs. Siemens Brothers' Dynamo Works, Limited, to correspond with the general style and decorations of the building, and are of the Georgian type. The Auditorium is lighted from the roof by means of two fifty-lamp electroliers, each 12 ft. high and 9 ft. in diameter, as well as by a large number of smaller fittings. Prismatic glass reflectors play a large part in the distribution of light. In addition, there are electric signs, and the exterior of the building is illuminated by twenty-two flame-arc lamps. All incandescent lamps are of tantalum and "Onewatt" metal-filament types. The total number of lamps in the whole building is close to 4000, and altogether the electric lighting and motor load represents over 400 hp. All the electric circuits are protected by Siemens "Zed" fuses, which insure the absolute security of the installation, owing to the great ease and rapidity by which the blown cartridge can be replaced and to the fact that it is impossible to replace one by another of a larger or smaller capacity. Part of the building is wired on the "Stannos" system and the remainder with rubber-covered wires drawn into enameled steel conduits. There are upward of thirty miles of wire installed,

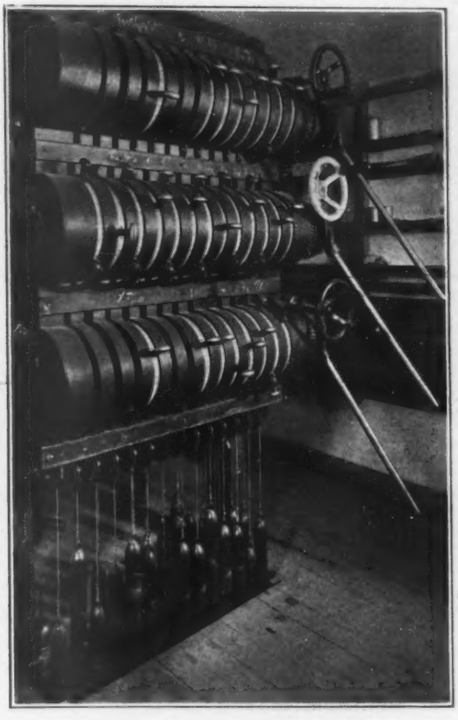


Fig. 3—Dimmer Control Board.

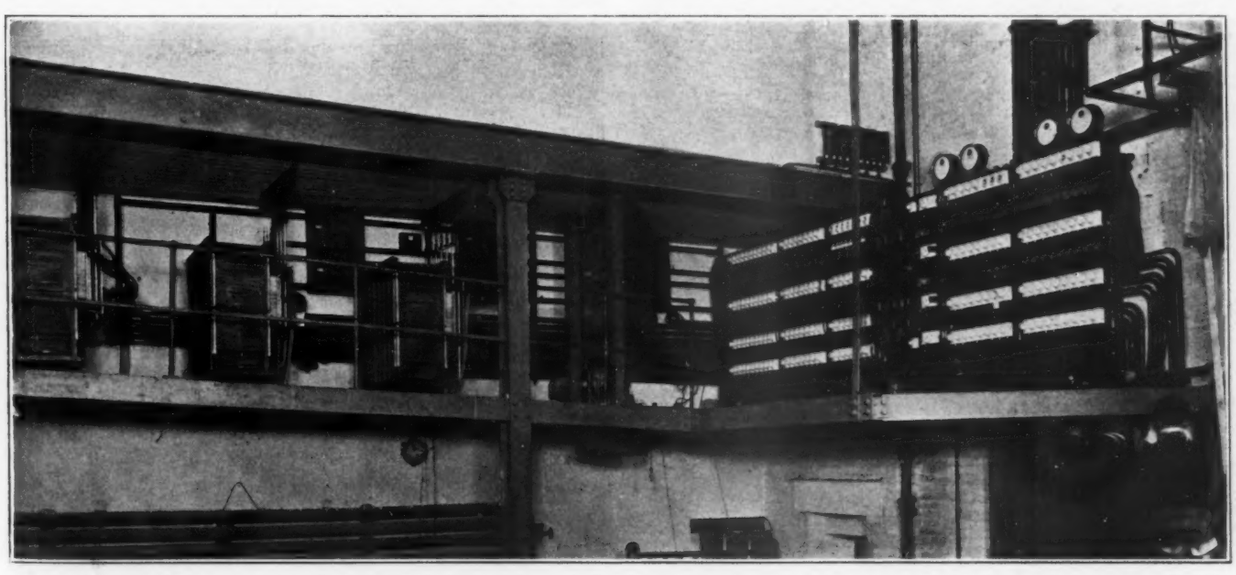


Fig. 2—Stage Switchboard.

and about eight miles of conduit. In addition to the electric lighting there are several telephone systems and electric bell circuits.

The supply company's cables for the stage-lighting effects consist of two lead-covered and armored cables, each 0.8 sq. in.,

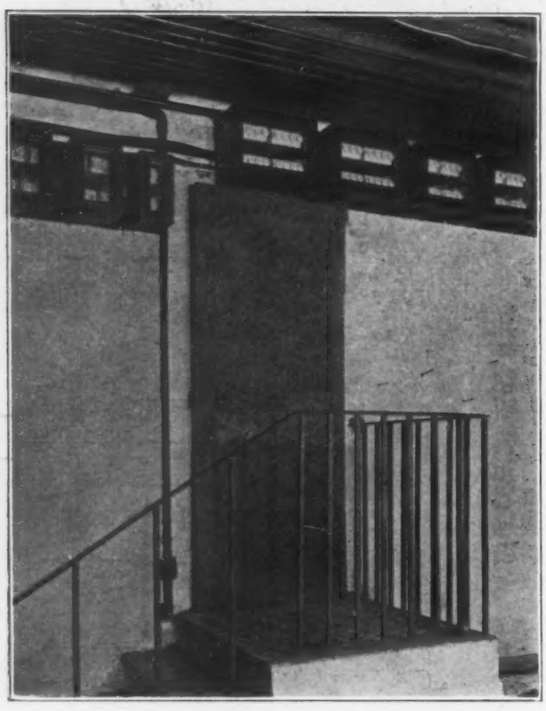


Fig. 4—Typical Wiring and Conduit Arrangement.

and one of 0.4 sq. in. section. The cables from the meter-room to the stage switchboard consist of four lead-covered and armored cables of 0.5 sq. in. section and two of 0.25 sq. in. section, which form two 110-volt circuits on each side of the three-wire system and one 220-volt circuit for the fans and other motors.

The stage switchboard is probably the largest of its kind that has yet been installed in Great Britain and it controls incandescent lamps and arc lamps taking approximately 2100

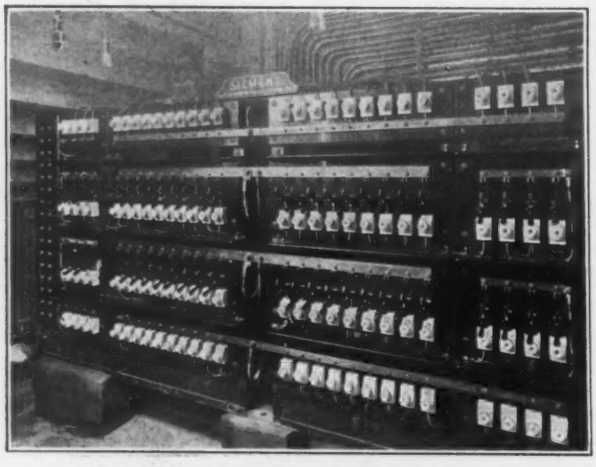


Fig. 5—House Switchboard.

amp at 110 volts. In order to obtain the necessary scenic effects master switches are provided, by means of which nearly all the lamps can be switched on and off simultaneously. In order to comply with the regulations of the London County Council all connections have been arranged on the front of the board and this has necessitated a somewhat special design so as to accommodate the larger number of lugs, etc., without interfering with the operation of the switches and fuses. The switchboard is divided into four horizontal sections, two on each side of the three-wire system. The circuits for each section of the lighting load are divided on the two sides of the system, so that under all conditions it will be approximately balanced. The circuits are grouped into four sections—

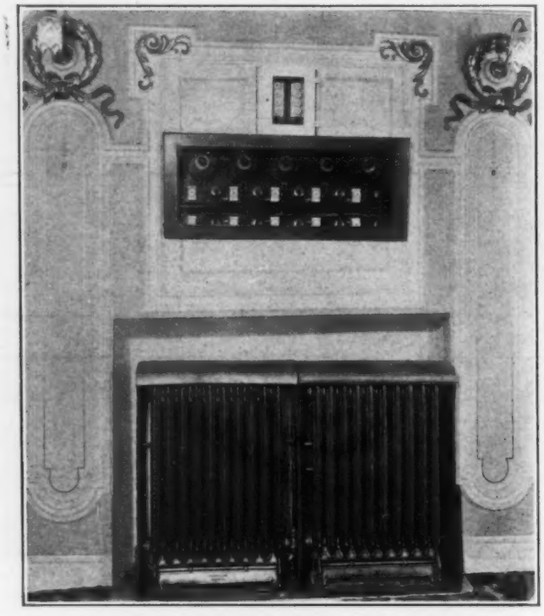


Fig. 6—House Distribution Box with Fan Regulators.

stage lighting through dimmers, general stage lighting, stage spot lamps and those auditorium spot lamps which are controlled from the stage. An additional panel carries the master switches referred to above. There are in all about ninety circuits provided, and on each are fitted double-pole fuses of the "Zed" type and a single-pole knife switch. A slate panel at one end of the board is equipped with a number of circular

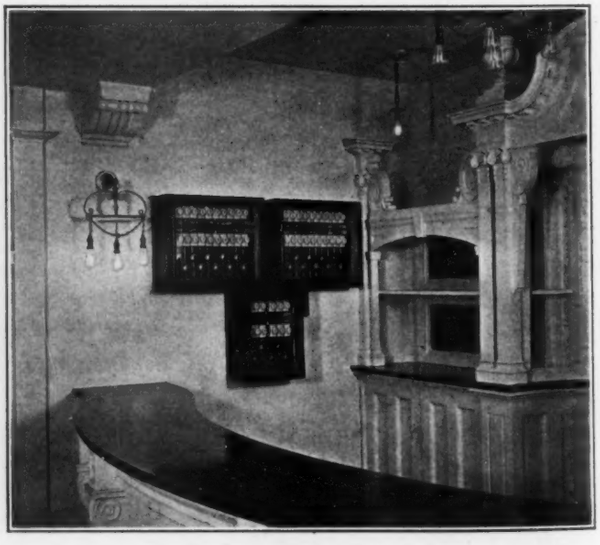


Fig. 7—House Distribution Board.

orifices in which a stock of spare fuse cartridges is kept ready for immediate use.

The complete control of the stage lighting in respect of color, dimming, etc., is effected from the dimmer board. This permits of producing in each separate group of lamps, entirely

in accordance with the will of the operator, all desired variations and combinations of light intensities and colors. The resistors employed at the Palladium differ in construction from those usually found in England, metal grids being used in place of liquid resistances. Every desired variation of light may be obtained by means of regulating wheels combined in

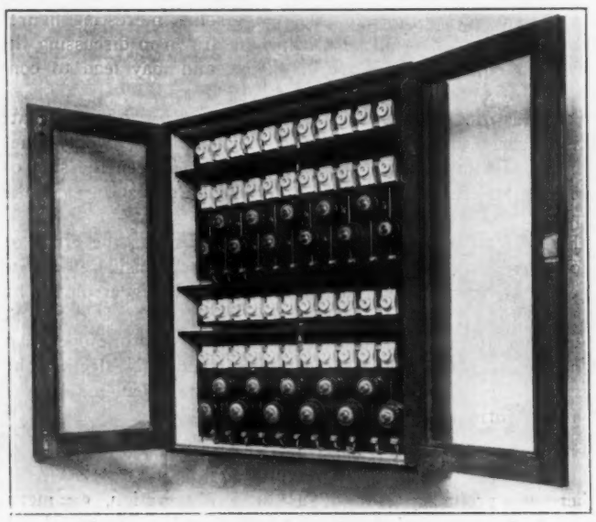


Fig. 8—Distribution Box.

the mechanism, all the lamps of one color in each border, strip, etc., being always controlled by one of these wheels. The latter are revolved by means of small levers, and are constructed in the form of pulleys, over which a cord, held in tension by a counterweight, leads to the sliding contacts of the resistance.

It is possible gradually to dim the lamps of one color while simultaneously another color, which is quite dim, may be increased to full intensity, so that not only is regulation of light intensity achieved, but also a mixture of the colors and a transition from one color to another with any desired total light intensity. All regulating wheels for the same color are mounted in one row and may be coupled together on to a common spindle, so that by turning a single hand-wheel situated at the side uniform movement of all the coupled levers is obtained and any desired groups of lamps of one color may be brightened or dimmed simultaneously. The coupling of the regulating levers is effected by hand-brakes which grip the cord pulleys, whereby the latter are moved all together by the common spindle. The hand-wheels can also be fitted with a fine regulation in order to obtain a specially slow and steady movement of all the coupled regulating levers. The cord pulleys are provided with scales and pointers, which permit of reading off the light intensity at any moment. By this means any particular adjustment of light can be noted and be reproduced later on as desired. The total current arranged for on the Palladium stage dimmers is 1140 amp. The number of regulating wheels is thirty-three, arranged in three rows. A switchboard for special lighting effects is situated at the back of the stage for providing light for properties and effects introduced by the various acts as required.

Fig. 9—Spot Lamp for Stage.

In order to provide a raised platform for special scenic effects and to facilitate the removal of scenery and properties to the basement, a portion of the stage floor, measuring approximately 20 ft. x 10 ft., is arranged as an electrically driven elevator. The control is of the semi-automatic push-button type, with separate push buttons for the up and down journeys. By the arrangement adopted the elevator comes to a standstill immediately the push button is released, and, therefore, permits of obtaining very correct adjustment of level.

A complete vacuum cleaning service is installed consisting of a Siemens "Vortex" cleaner located in the basement underneath the stalls and connected to a system of pipes which run to eleven outlets distributed throughout the house. The machine is driven by a 5-hp, 220-volt direct-current motor.

The system is characterized by absence of gearing, valves and reciprocating parts and is automatic and noiseless in operation. About 500 ft. of 2-in. and 1½-in. steel piping is run in the walls and serves nickeled connection pieces at the outlets. Flexible hose in lengths of 16 ft. can be connected to any one of the outlets so as to reach all seats, etc. The nozzles and other fittings are connected by simple conical plug and socket jonts.

The circuit wires for the borders are carried from the stage switchboard through the dimmers and connected to the various multiple stage plugs which are fixed on the border bridges. Similar plugs are mounted at one end of each of the borders, to which the wires from the lamps are connected. Suitable lengths of flexible multiple connecting cables are supplied for the purpose of connecting the borders to the bridges and to enable the borders to be disconnected easily when it is required to raise or lower them. These flexible lengths of cable are fitted with plug sockets at each end, and at the points where the wires in the cable are connected to these sockets they are laid in grooves formed in the handle portion of the socket

Fig. 10—Chandelier in Auditorium.

and strongly bound round with leather. The plugs are so arranged that it is impossible for them to be inserted in the wrong manner and are fitted with a locking attachment to prevent accidental disconnection. The arrangement permits of easy detachment and replacement. A number of spot lamps are provided, one being fixed on each border alternately at the

right and left ends of the borders. These lamps are connected to a multiple way switch on the stage switchboard. This switch is of the rotating type, and when the handle is moved round rapidly the lamps are switched on in rapid succession for the fraction of a second only, whereby a forked-lightning effect is produced.

The spot lamps are extremely powerful and similar in construction to those usually employed for marine work. The larger projectors, of which three are in use in the biograph room at the back of the roof and two in the projector room in the center of the roof, take a current of 45 amp each The small lamps which are fixed at the sides of the proscenium and on the stage bridges, as well as the portable ones, take 35 amp each.

A switchboard is situated in the front of the building similar in general design to the stage switchboard, and consists of three sets of panels controlling the general house lighting, exterior arc lamps and that portion of the auditorium lighting also controlled from the stage switchboard but which has to be cut-out for certain acts. Fifty-four circuits are provided for, each of which is fitted with double-pole fuses of the "Zed" type and a single-pole knife switch. A smaller switchboard connected to the alternative supply is also mounted in the same situation. There are fourteen "Typhoon" fans about 50 in. in diameter mounted on the ceilings under the balconies for assisting in the ventilation of the auditorium, and a number of table fans are provided for the saloons, etc. The wiring on the stage and in the auditorium is controlled from a number of distribution boxes which are in turn fed from the main switchboards. The distribution boards have several special features. The fuses and switches are fixed on the enameled slate panels in an improved manner, so that the back of the slate is free from any drilling, screws or connections. This feature has resulted in the attainment of very high insulation resistance. All terminals, busbars and connections are on the front of the slate and the greatest care has been devoted to securing easy wiring and accessibility. The cabinets are of hand-polished teak, or sheet or cast iron, and are asbestos-lined, glazed with plate glass and fitted with circuit labels and strong lever locks in accordance with the architect's specifications.

Regulating switchboards for the fans are provided on the walls at the back of the gallery promenades. Fig. 4 shows some of the wiring and circuit arrangements and is indicative of the substantial manner in which these essentials have been constructed.

The boxes are fitted with telephone instruments which are connected to a telephone exchange in the Louis XV saloon. By this means the occupants of the boxes can communicate with the various refreshment rooms, or with each other. Loud-speaking telephones are fitted on the stage, connecting with the royal box and the stage manager. The instruments on the stage have short trumpets; the speaking is very distinct and can be heard clearly from a distance of 5 yd. to 10 yd. Intercommunication telephones are fitted in other parts of the house and on the stage for the convenience of the theater staff.

Letter to the Editor.

Slide-Rule Errors.

To the Editor of Electrical World:

Sir:—In your first issue of April Mr. W. L. Durand in discussing the errors of slide rules gives some interesting figures from sixty actual tests, the conclusions drawn in discussing the observed data of which are erroneous and may lead to confusion. His data were:

Number of observations, sixty; greatest error, 0.15 per cent; least error, 0.00 per cent; number of plus errors, twenty-nine; number of minus errors, thirty; difference between the sum of the plus and minus errors, 0.60 per cent; "average of all the errors," 0.06 per cent.

He takes 0.60 per cent $\div 60 = 0.01$ per cent as the error of each operation, when it should be, of course, considered as the average systematic error introduced by engraving errors or by the warping of the rule itself.

He also states that "the probable error for any one operation should not exceed one-tenth of 1 per cent." Neglecting the systematic error, the probable error can be calculated by the ordinary formulas

$$v = 0.6745\,\epsilon = \sqrt{\frac{\pi}{2}}\,\eta,$$

where v = probable error of a single observation, ϵ = mean error (square root of the mean square), and η = mean of the errors (arithmetical mean without regard to sign), which in this case is 0.06 per cent.

$$\eta = 0.06 \text{ per cent.}$$
$$\epsilon = 0.075 \text{ per cent.}$$
$$v = 0.05 \text{ per cent.}$$

In the use of the slide rule the errors are in a series of observations, such, for example, as in taking out the product of several numbers. By some peculiar process of reasoning Mr. Durand arrives at the conclusion that the probable error of a single operation depends upon the number of operations in a series, and also that the probable error of a calculation involving five operations is no greater than that of a single operation. For the probable error of a calculation involving five operations we should, of course, have a probable error of

$$\sqrt{5}\,v = \sqrt{5} \times 0.05 \text{ per cent} = 0.11 \text{ per cent.}$$

As before mentioned, a warping of the rule may introduce systematic errors, which will depend upon the part of the scale used. For example, I have used a 20-in. rule which was bowed only 3/32 in., yet this made the slide 0.1 per cent longer than the rule. They were the same length as closely as could be read when the rule was straightened by pressing against a flat surface. The accuracy actually attained on a good 10-in. rule is often given as 0.2 per cent.

The matter of the uniform percentage accuracy of the logarithmic scale, such as that of the slide rule, has often been discussed, as, for example, in Edgcumbe's "Industrial Electrical Measuring Instruments."

Bureau of Standards, Washington. P. G. Agnew.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Self-Exciting Three-Phase Commutator Generators.—R. Rüdenberg.—Three-phase commutator machines the stator and rotor circuits of which are connected together can be made self-exciting under suitable conditions to transform mechanical energy into the electrical energy of three-phase currents. The author discusses the behavior of such machines when loaded. The problem is discussed only for the special case in which the stator and the rotor have the same number of turns and the resistances and leakage reactances are the same in the stator and the rotor. The author shows that when such a three-phase machine is loaded with a non-inducting load it is able as a generator to give at full voltage a current which is approximately four times the value of the short-circuit current when the machine operates as a motor.—*Elek. u. Masch.* (Vienna), March 12.

Induction Motor.—A note on a recent British patent (4871, April 6, 1911) of H. Maxwell (Schenectady, N. Y.). To

improve the torque of induction motors with squirrel-cage rotor windings, the connections between the rotor conductors and the short-circuiting rings are doubled back upon themselves so as to have an appreciable length and resistance with minimum self-induction.—Lond. *Elec. Eng'ing,* April 13.

Lamps and Lighting.

Metallic-Filament Lamps.—An account of life tests of metallic-filament lamps made at a testing laboratory in London. Four lamps made by each of fifteen factories were tested, and were not specially selected for the purpose, but were ordinary commercial lamps of 25 cp made for use on 200 volts. Curves are given for the four lamps of one company which show that after 2000 hours not only were these lamps still intact when taken off the test, but also that the candle-power of each lamp is represented as practically a straight line, showing that the light given initially was maintained throughout the run. The total watts taken by the lamps and the watts per candle-power also remained practically constant throughout the run.—Lond. *Elec. Eng'ing,* March 30.

Tungsten Filament.—A note on a recent British patent (19,932, April 6, 1911) of A. G. Bloxam (Siemens & Halske A. G.). It covers a process of manufacturing a ductile alloy of tungsten with nickel by heating a mixture of tungsten and nickel powders or oxides of these metals, which are afterward reduced in order to obtain a ductile rod of alloy. At a certain critical temperature (1510 deg. C. for an alloy of 90 per cent tungsten and 10 per cent nickel) the alloy changes, so that when cold it is ductile enough to be rolled and then drawn into filaments The nickel is volatilized so as to leave a pure tungsten filament by passing a current through the filament in a vacuum.—Lond. *Elec. Eng'ing,* April 6.

Inclosed-Arc and Metallic-Filament Lamps.—The author discusses the competition between metallic-filament lamps and inclosed-arc lamps and says there is no reason why the latter should be supplanted by the former. He gives an estimate of cost for a shop to be lighted by eight lamps, each of 50 cp, and finds that the inclosed-arc lamp is considerably cheaper than the metallic-filament lamp installation.—Lond. *Elec. Review,* March 31.

Traction.

Single-Phase Traction.—O. BANDOW.—A paper discussing some of the work done by the Bergmann Company on single-phase traction. The author shows that for a relatively low number of revolutions per minute and correspondingly low speed, such as is required for freight locomotives, and if the frequency is sufficiently high, the repulsion motor is electrically equivalent to the series motor, but on account of the simple method of control of the repulsion motor the latter is superior to the series motor. On the other hand, for high speed the series motor is superior to the repulsion motor. The author finally discusses why the electrical equipment of trunk-line railroads is making relatively slow progress. This is due to the large amount of capital required, and it must be made sure in each case that the change will be profitable. To make heavy electric traction pay, the price of electrical energy should preferably be not more than 0.5 cent per kw-hour and certainly not higher than 1.25 cents per kw-hour.—*Elek. u. Masch.* (Vienna), April 2.

Electric Traction in Sweden.—I. A. ÖFVERHOLM.—An illustrated article stating that the first section of the Swedish State railway system to be converted to electric traction is the 80-mile single-track line between the mining center of Kiruna and Riksgränsen, on the frontier of Norway. Energy will be supplied from a hydroelectric station, some 120 miles distant from the middle of the line, over a 50,000-volt, single-phase transmission line. The energy will be supplied at 15,000 volts, 15 cycles, to heavy locomotives, with commutator motors of the compensated-series type. Besides a few passenger trains eight heavy ore trains, each consisting of forty ore trucks and two locomotives, and weighing 2050 tons, will run daily from Kiruna to Riksgränsen, and as many in the return direction.—Lond. *Elec. Eng'ing,* April 6.

Installations, Systems and Appliances.

Small Electric Plants.—A. W. SCHLEYEN.—In districts with very small populations electric-distribution systems are not profitable and isolated plants are preferred. The author gives recommendations on the erection of such small isolated plants and suggests the standardization of gasoline engines, generators, switchboards and storage batteries for such purposes so that they can be built in large quantities and at a relatively low price. In that case such small plants would become profitable. —*Elek. u. Masch.* (Vienna), March 26.

Small Electric Lighting Plants.—C. B. WALKER.—A paper read before the Birmingham and District Electric Club. The author, after discussing the main features of a private plant for electric lighting, describes a plant which is entirely automatic in its working, being self-starting, self-stopping and self-regulating.—Lond. *Electrician,* March 31.

Electricity in Mines.—R. NELSON.—The author gives an analysis of the accidents which have occurred in British mines due to the use of electricity, the analysis being made up entirely from material contained in the annual reports of the British inspectors of mines. He also makes some suggestions as to the safeguards to be observed in the construction and operation of apparatus.—Lond. *Electrician,* April 7.

Wires, Wiring and Conduits.

Insulating Compound.—A note on a recent British patent (9933, March 30, 1911) of R. G. Sharp. A filling for cable troughs consisting of pitch and an equal quantity by weight of merely ground whinstone or granite. The two substances are well mixed together when the pitch is in a molten condition.—Lond. *Elec. Eng'ing,* April 6.

Reinforced-Concrete Poles.—M. FOERSTER.—A translation in abstract of his recent German paper on reinforced-concrete poles for arc lamps.—Lond. *Electrician,* April 7.

Electrophysics and Magnetism.

Absorption of Electrons.—O. W. RICHARDSON AND H. L. COOKE.—An account of an experimental investigation of the heat liberated during the absorption of electrons by different metals. The heating effect due to the difference of the potential energy of an electron inside and outside of a conductor, which the authors previously established for platinum, occurs in other metals. The effect is of the same order of magnitude in all cases, the measured values ranging from about 4.5 volts to 7.5 volts. The values are influenced very considerably by the nature and state of the thermionic emitter. The measured effect is not influenced by changes in the pressure of the residual gas in the apparatus, provided this be reasonably low. Under certain conditions, not yet completely determined, the thermionic emission from osmium becomes unstable, and there are two ranges of stability, one at low and the other at high temperatures.—*Phil. Mag.,* April.

Variation of the Ionization with Velocity for the Beta Particles.—W. WILSON.—A note on a recent Royal Society paper. Rays of different speeds were separated by means of a magnetic field from the heterogeneous beam given out by the active deposit from radium. The relative numbers of particles corresponding to the different speeds were determined by measuring the charges gained per second by an insulated copper vessel which was placed in the path of the rays and was thick enough to absorb them completely. The corresponding ionizations were determined by a separate experiment, and were corrected for scattering of the rays by the walls of the ionization vessel. The results obtained were as follows: The ionization produced per centimeter by beta particles in free air varied inversely as the square of the velocity between the limits examined. The ionization in a thick copper vessel was not connected with the velocity by any simple law, but can be approximately represented by $I = k\,(c - v)$, where I is the ionization, v the velocity of the particles, and k and c constants.—Lond. *Electrician,* March 31.

Alpha Particles.—T. S. TAYLOR.—An investigation on the ionization of different gases by the alpha particles from polonium and the relative amounts of energy required to produce an

ion. The energy of the alpha particle consumed in the production of an ion depends upon the nature of the molecule ionized. Apparently it requires less energy to produce an ion in the gases or vapors which have heavy or relatively complex molecules than it does in those gases of lighter or less complex molecules. —*Phil. Mag.*, April.

Röntgen Radiation.—J. C. Chapman.—An account of an experimental investigation of the homogeneous Röntgen radiation from vapors. The object was to show that the same type of homogeneous radiation is emitted by the elements, whether they are in the solid state or in the form of vapor.—*Phil. Mag.*, April.

Radioactivity.—W. Duane.—An account of experiments in which the author endeavors to measure the heat generator of radio substances.—*Am. Jour. of Science,* April.

Electrochemistry and Batteries.

Action of Electric Discharges of Nitrogen Gas.—A note on a recent lecture by R. J. Strutt on a chemically active modification of nitrogen produced by electric discharges. The following facts have been established experimentally: Pure nitrogen from whatever source subjected at a low pressure to the jar discharge undergoes some modification which causes it to glow for a short time after it has been sucked away from the discharge. The glow which is emitted while the gas returns to its normal condition is not destroyed by the removal of ions. It is weakened by heating, intensified by cooling. This seems to favor the view that it is due to the re-combination of dissociated atoms. The modified nitrogen acts on ordinary phosphorus, combining with it, and at the same time forming much red phosphorus. It combines with sodium and also with mercury at a gentle heat (say, 150 deg. C.), forming in the latter case an explosive compound, and in each case developing the line spectrum of the metal concerned. It also develops the line spectra of other metals, probably combining with them. It develops the band spectra of compounds when these are vaporized in it, giving in many cases spectra of substances too unstable to be examined at the temperature of the Bunsen flame. It attacks acetylene and substances like ethyl iodide or chloroform, setting the halogen free when there is one, and combining with the carbon to form cyanogen. This is proved by the brilliant cyanogen spectrum produced and by direct chemical tests, such as the formation of Prussian blue. It attacks nitric oxide with the formation, strangely enough, of nitrogen peroxide, a more oxidized substance.—Lond. *Electrician,* April 14.

Electric Steel.—An illustrated translation in abstract of a recent German paper on the electrical production of steel at the works of the Eicher-Hüttenvereins Le Gallais Metz & Company at Dommeldingen, in Luxemburg.—Lond. *Electrician,* April 14.

Units, Measurements and Instruments.

Proposed International Symbols.—D. Robertson.—The author does not agree with Trotter's recent recommendation to avoid script letters for magnetic quantities. He emphasizes that there are not sufficient letters in the alphabet to assign one to each of the physical quantities, and hence most of them must be used more than once. It is, therefore, desirable to distinguish between them by taking different styles of letters for different groups. He uses grotesque (block) type for the geometrical and mechanical quantities, ordinary type for electrical and script for magnetic ones. In addition he employs italics for thermal ideas, and heavy italics for algebraic work, and he looks for another font for luminous things. He is opposed to the proposed use of suffixes to indicate the various values of an alternating quantity.—Lond. *Electrician,* April 7.

Testing Transformer Iron.—L. W. Wild.—An abstract of a paper on an investigation of the system employed by the Bureau of Standards in Washington, in which a number of strips, each 10 in. x 2 in., are built up into a square with interleaved joints with special bent corner pieces. Coils are slipped over two opposite sides of the square, and an alternating-current wattmeter is used in conjunction with an electrostatic wattmeter to determine the losses in the iron. The final conclusion is that the method is not very suitable for the particular alloys tested, and that if it should be decided that the interleaved method with rounded corners is the most accurate it is hardly necessary to trouble about cutting the corners round. If the amount of waste material at the corners is deducted from the gross weight the results obtained will not differ by more than 1 per cent from the results that would have been obtained had the corners been rounded. It appears, however, to the author that the interleaved method is still the best available method of testing transformer iron. It is generally agreed that if accurate results are to be obtained the strips must be annealed after being cut, and this can be done properly only by the manufacturer. There is no special virtue in using wide strips. Strips, say, 10 in. x 1 in. would be in many ways preferable to strips 2 in. wide. Corner effects could be reduced by one-half and, with the same area of iron the length per turn in the magnetizing coil would be reduced, thus reducing the *IR* drop and improving the form factor.—Lond. *Elec. Eng'ing,* April 6.

Galvanometer Used as Electrometer.—W. Peukert.—An illustrated article on the use of mirror galvanometer of the Deprez-d'Arsonval type as a substitute for the electrometer for

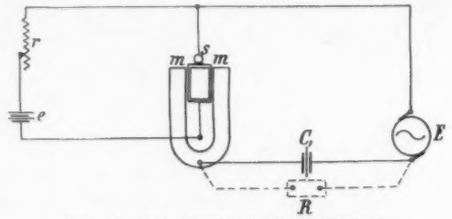


Fig. 1—Arrangement of Apparatus.

alternating-current voltage measurements. This possibility is due to the fact that such a galvanometer is in principle of the same construction as an electrometer since the movable coil of the galvanometer corresponds to the needle of the electrometer and the magnet system to the quadrant. If, therefore, the coil is connected to one pole of the voltage to be measured and the magnets to the other pole there will be a deflection which can be measured as in the ordinary use of the galvanometer and which is now an indication of the voltage. The normal position of the coil in the galvanometer is such that the sensitiveness of the instrument when used as an electrometer would be low. It is, therefore, necessary to turn the coil out of its normal initial position when it is to be used as an electrometer. It is easiest to produce this deflection by direct current. The arrangement is

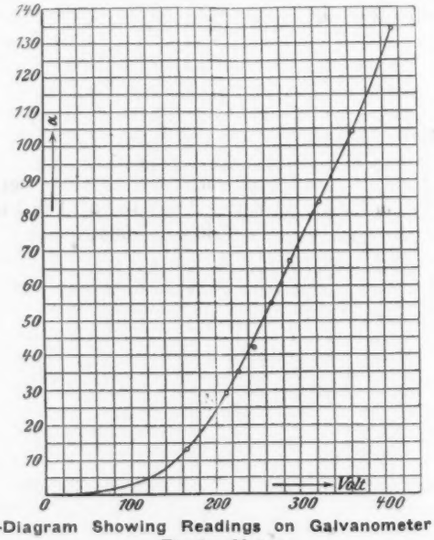


Fig. 2—Diagram Showing Readings on Galvanometer Used as Electro-Meter.

indicated in Fig. 1. The coil *s* is connected to a small storage battery *e* in series with an adjustable resistance *r*. The alternating-current voltage to be measured is *E* and when connections of *E* to *m* and *s* are made as indicated there will be a deflection. By giving different values to the resistance *r* and measuring in each case the deflection due to the alternating-

current voltage E it is possible to find such a value of the adjustable resistance r that the deflection of the instrument when used as an electrometer is a maximum. The scale can be varied by condensers C in the well-known manner. Fig. 2 gives the results of a test of a galvanometer when used for measuring alternating-current voltages from 0 volt up to 400 volts. The abscissas are volts, the ordinates deflections.—*Elek. Zeit.*, March 13.

Wattmeters at High Frequency.—E. BEHNE.—A paper on errors shown by wattmeters at high frequencies. The author shows in which way the wattmeter reading is influenced by mutual induction between the stationary and the movable coils and by the self-induction of the latter coils. Numerical data are given for 500 cycles per second. The formulas show that the errors can be avoided if the induction of the movable coil is compensated by a suitable capacity. Experiments showing the effectiveness of the method are described.—*Elek. u. Masch.* (Vienna), March 26.

Localizing Fractures in Submarine Cables.—R. R. BLACK.—The author first gives the general laws concerning the resistances and the emfs located at exposures in broken cables in sea water. He then discusses various methods of localizing fractures in cables and their sources of error with special reference to the reduced-current method.—Lond. *Electrician*, April 7.

Earth Inductor.—J. E. IVES AND S. J. MAUCHLY.—An illustrated description of a new form of earth inductor for measuring the vertical component of the earth's magnetic field directly without the use of the magnetometer and the ordinary rotating earth inductor.—*Phil. Mag.*, April.

Definitions.—The Austrian Electrical Committee gives definitions of thirty-eight important terms used in electrical engineering. They are partly identical with those recently recommended by the German Association of Electrical Engineers. A number of symbols and several rules on rating are also recommended.—*Elek. u. Masch.* (Vienna), April 2.

Telegraphy, Telephony and Signals.

Oscillatory Currents in Coupled Circuits.—G. W. O. HOWE.—An illustrated abstract of a paper read before the Physical Society in London. The author describes the method of demonstrating with an oscillograph the currents in coupled oscillatory circuits containing capacity and inductance. The oscillation of energy between the circuits is discussed mathematically and the conditions are shown to agree with experimental results. The quenching of the spark in the primary circuit is finally considered.—*Lond. Electrician*, April 14.

Miscellaneous.

Electricity in Agriculture.—J. H. PRIESTLEY.—A lecture before the Farmers' Club in London on electricity as a factor in crop production. The bulk of the lecture was a recapitulation of the experiments which have been carried out by J. E. Newman, in conjunction with Sir Oliver Lodge and Lionel Lodge, and with the co-operation of Raymond Bomford, of Evesham, supplemented by experiments by Priestley himself. In these a network of wires erected over the land under cultivation is kept charged with positive electricity at high potential. He also dealt with the application of electric light in greenhouses for stimulating plant growth, and mentioned experiments with a glass-tube mercury-vapor lamp and also with a quartz-tube mercury-vapor lamp. The results of the experiments so far seem to indicate that plants exposed to the lamps grew more rapidly and, if anything, were more sturdy than plants not exposed in this manner. There were no signs of the lanky, unnatural extension of the plant usually associated with forcing. An account of the discussion which followed is also given.—Lond. *Elec. Eng'ing*, April 6.

Phase.—A note on the different meanings which the term "phase" has gradually assumed, its original meaning being that of a certain moment in a periodic phenomenon. The author does not like the term single-phase and two-phase currents and recommends single-wave and two-wave currents.—*Elek. u. Masch.* (Vienna), April 2.

BOOK REVIEWS.

WORKINGMEN'S INSURANCE IN EUROPE. By Lee K. Frankel, Ph.D., and Miles M. Dawson. New York: Charities Publication Committee. 480 pages, 145 tables. Price, $2.50.

WORK ACCIDENTS AND THE LAW. By Crystal Eastman. New York: Charities Publication Committee. 350 pages, 38 full-page illus. Price, $1.65.

These two handsome volumes are a striking proof of the growing interest in the "conservation of life" as the highest and most important of all natural resources. They constitute part of the Russell Sage Foundation issues and are a distinctly valuable addition to the data of the subjects of which they treat, data that are useful alike to the economist, the industrialist and the philanthropist. The first book, on workmen's insurance, is larger than the other in scope and suggestiveness; but the second, by its poignant and tragic examples, drawn from real observation at close hand in Pittsburgh, drives the lesson home.

The Frankel and Dawson book is in four parts, namely, insurance against accidents; insurance against sickness and death; insurance against invalidity and old age; and unemployment insurance. These topics are again subdivided to show what is done by public and private means in cases of accident; and also in regard to sickness, maternity, funeral and other expenses. The subjects of invalidism and old age and of pensions to widows and orphans are also treated most carefully. A most valuable part of the work is that which treats of defects in the various systems and the need of a complete and connected plan that shall prevent economic waste under whatever guise it may appear in the attempt to cure the greater economic waste at which the whole policy is aimed. In many ways Chapter XVII, for this reason, is the one that American students will perhaps find most interesting, as well as the chapters that follow it detailing various reform projects in Germany and Austria.

Such literature as this deserves the closest study. We have only the beginnings of such insurance in America, but it is fast becoming a national as well as a local issue. The work of the National Civic Federation and the educational efforts of the Museum of Safety and Sanitation in New York are symptomatic of aroused attention on the part of the public, and meantime the legislator is getting busy. No greater fields of industrial employment exist than those affected by electricity, and it is our common duty to help make those fields as safe and secure as possible for all who enter them.

VORLESUNGEN ÜBER TECHNISCHE MECHANIK. By Dr. August Föppl. (In six volumes.) Vol. VI. Leipzig: B. G. Teubner. 490 pages, 30 illus. Price, 12 marks.

This is a carefully written textbook on certain problems in higher applied mechanics, prepared for advanced students of mechanics and mathematics. The principal subjects treated are single and double pendulums, the gyrostat, the centrifugal governor, planetary motions and wave motion. The treatment of these problems is essentially that of the physicist and mathematician rather than that of the engineer—that is, from the standpoint of pure rather than of applied science. The book will be of interest to advanced students of higher mechanics. Although belonging to a set of six volumes by the same author, this volume is practically complete by itself in the department it covers.

NOTES ON MECHANICAL DRAWING. By Horace P. Fry. Philadelphia. 55 pages, 34 plates.

This textbook has been prepared especially for the use of students in mechanical engineering at the University of Pennsylvania, and contains instructions in the preparation of detail sketches, shaded drawings, dimension sheets, lettering, tables, problems in elementary descriptive geometry, etc. Data on bolt and screw threads, sizes, dimensions, etc., are also included for the aid of draftsmen.

Conduit Wiring. By Laurence M. Waterhouse. London: Simplex Conduits, Limited. 180 pages. Third edition.

The third edition of "Conduit Wiring," bringing its total issue to 20,000 copies, appears with the matter on conduit work largely rewritten and revised, while special chapters have been included on electrical break-downs, lamps, illumination, ventilation, cabling, etc. Tables of wiring capacity and illustrations of model conduit installations are included in the pages. Several interesting opinions on the alleged electrical-wiring hazard, quoted from the British Fire Office Engineers, leave no room for doubt that, over there as here, modern approved conduit construction is regarded as providing the maximum safety from electrical fires.

Les Substances Isolantes. By Jean Escard. Paris: Gauthier-Villars. 313 pages, 182 illus. Price, 10 francs.

A descriptive treatise on the various insulating substances employed in electrical industries, their methods of test and their limitations. The principal chapters are on general considerations, the characteristics of insulators, the metalloidal insulators, mineral insulators, guttapercha and resins. Much attention is given to the nature and properties of the insulators employed on high-tension conductors, both aerial and subterranean. Methods of construction, analysis and testing are given. The book will be useful to high-tension manufacturers and engineers. It contains an unusually long list of insulating substances and gives much useful information concerning them.

New Apparatus and Appliances

SHOCK-RESISTING QUALITY OF ELECTRIC AUTOMOBILE.

One of the most remarkable incidents of the fatal New York Central explosion of last December was the lifting of a trolley car from its tracks and overturning it on a passing automobile. That same automobile, after a brief sojourn in the repair shop, is back in service. Its running gear, which was submitted to such great strain, was found to be practically uninjured. There are a few new spokes in one forward wheel, a new steering knuckle on the front axle, new tires and body, but the chassis, axles, wheels and even the springs were not damaged, while only four of the forty storage-battery cells were cracked. The automobile was an electric machine used by Mr. S. G. Rhodes, of the New York Edison Company. It was built by the Baker Motor Vehicle Company, Cleveland, Ohio.

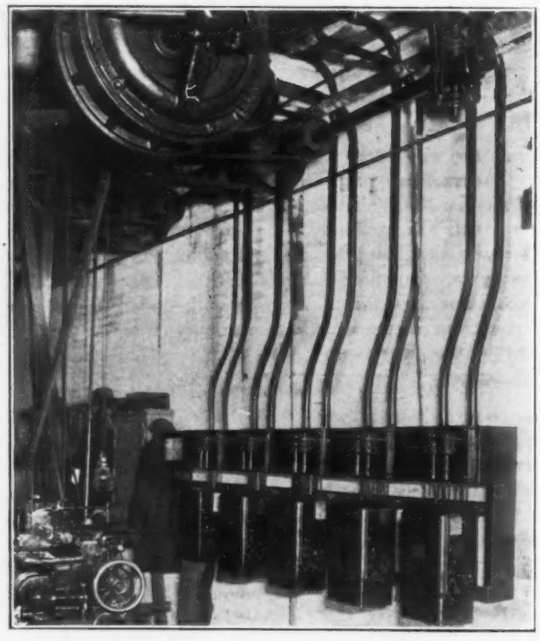
MOTOR-STARTING AUTO-TRANSFORMERS.

A motor starting auto-transformer consists of an inductive winding with taps, a switch for connecting the taps to the motor and a hand-operated lever handle and automatic release mechanism for operating the switch. The winding comprises a coil for each phase wound on a separate leg of the laminated core and provided with several subvoltage taps, any one of which may be selected, by trial, as suitable for the starting requirements of any particular case. The switching device in the starter here shown consists of pipe contacts, immersed in oil, and carried by a switch shaft extending through the sides of the compensator case. To one end of the switch shaft is attached the hand-operated lever, and to the other end the external spring return lever, through the medium of which the automatic release devices operate in conjunction with the hand-operated mechanism.

The automatic release mechanism consists of overload and no-voltage relays, tripping levers and spring-return levers, which operate automatically to return the switch to the off position from either the starting or running positions, if it should happen to be carelessly or accidentally left on the former, or in case of overloads or voltage failure when it is being held on the latter.

The spring-return levers are mounted on the switch shaft and are actuated by a spring against the tension of which the switch is thrown by the lever handle to either the starting or running positions. Consequently, if at any time the switch should happen to be left on the starting position, the tension of the spring will automatically return it at once to the off position. On the other hand, when the switch is thrown to the running position, the tripping lever of the no-voltage relay engages the external spring-return lever and holds the switch in that position until the spring-return lever is released either by hand or by the dropping of the plunger of the no-voltage relay, in case of either overload or voltage failure, thus permitting the spring to return the switch to the off position.

The no-voltage relay consists of a solenoid coil and plunger. In case of voltage failure, with the switch in the running position, the de-energizing of the solenoid coil allows the plunger to drop, thereby depressing the tripping lever and releasing the spring-return lever, thus permitting the spring to return the



Starting Auto-Transformers Controlling Induction Motors.

switch quickly to the off position. Therefore, by inserting a normally closed push button in the energizing circuit of the no-voltage release coil, it is possible to stop the motor from a remote point. In the off position both the compensator and the motor are disconnected from the line and are thus effectually protected from the returning full-line voltage.

The overload release comprises two series trip coils inserted in the running circuit. By the use of oil dash pots they are unaffected by the usual rush of current at starting, but can be adjusted to operate on a slight increase in current above normal and to open the no-voltage relay circuit, thus allowing the switch to be snapped back from the running to the off position

by the action of the spring, as already described. The overload relays are employed where fuses are undesirable, and like the latter are mounted on a separate panel. They are more convenient in all cases, however, as their use saves the expense and time lost in replacing fuses.

These starting auto-transformers are built by the General Electric Company in two types, the wall-suspension type and the floor type. The former includes sizes for motors of from 5 to 100 hp. Those of the floor type are suitable for motors of larger rating.

GROUNDING OF SECONDARIES.

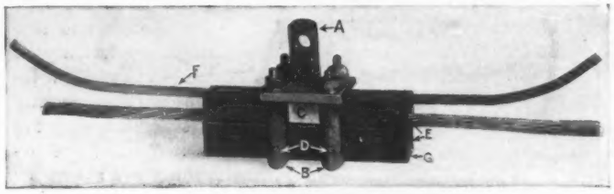
Following the recent action of the Underwriters' National Electric Association in recommending the grounding of secondary circuits up to 150 volts, the Paragon Sellers Company, of Chicago, which makes a circuit-grounding cone, calls attention to the various methods of making ground connections possible by this device, as shown by the accompanying diagrams. Many electric-light companies ground their secondaries either to water mains or to home-made grounding devices. Other companies have put the matter off because they have been prohibited from using water mains or have been unable to secure reliable ground connections at a reasonable cost.

Undoubtedly the best ground connection is to a water system. In some cities, however, this is prohibited owing to the fear of injury to the underground pipes due to electrolysis. Whenever a transformer breaks down or a circuit is crossed, there is only a momentary flow of current to the ground, until the fuse or the circuit-breaker opens. This momentary flow is alternating in character and therefore has no electrolytic effect. Hence the water main can be safely used for this purpose, and it is usually recommended whenever it is practicable to make it without undue expense. But where water mains are not available, or where a portion of the street, sidewalk or basement must be torn up in order to get to a water connection, some other method of grounding must be used.

Under these circumstances the advantages of the ground cone are evident. Iron pipes or rods or copper plates are sometimes found to be unreliable. Moist earth is a prime essential. This must be obtained without rusting or corroding the metal. The Paragon ground cone consists of a perforated cone of pure copper filled with charcoal. It presents a large discharge area and allows moisture to be retained by the charcoal. A hollow braided cable into which the ground wire is to be run and soldered is an integral part of the cone. No salt is required to produce moisture and the cones are easily installed by using a 6-in. post-hole auger. The accompanying diagrams, showing the manner in which the cones are connected for various classes of service, are of considerable interest.

SUSPENSION CLAMP FOR HIGH-TENSION CONDUCTORS.

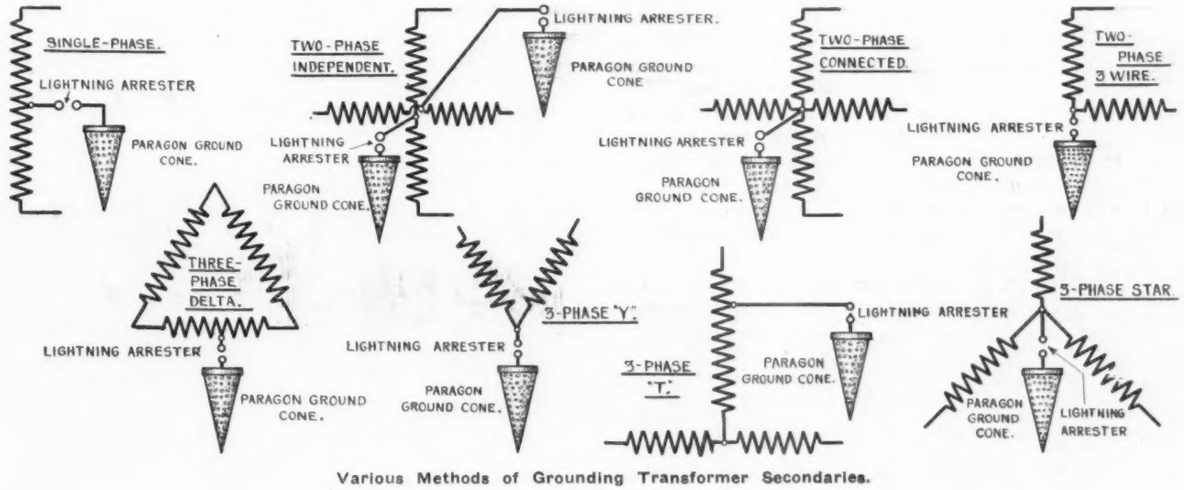
In the transmission of energy at high voltage using suspension-type insulators it is the common practice to use stranded conductor either of copper or aluminum. In order to suspend the conductor from the lower unit of each series a clamp of some form is used. Heretofore most of the clamps were made of metal, but in a new design, invented by Mr. R. A. Willson, general superintendent of railways, Washington Water Power Company, of Spokane, Wash., and employed with great success on transmission lines since their construction early in 1910, use is made of two wooden clamping blocks in place of the metal clamps. One of the chief advantages of this clamp is that, the wood being soft to a certain degree, the clamping members will not injure the cable. This is especially advantageous where aluminum cable is used, as it is well known that aluminum cable can be seriously injured by being clamped too tightly.



Suspension Clamp for High-Tension Conductors.

Referring to the accompanying illustration, the clamp is attached to the clevis casting of the lower insulator unit by means of the suspension member *A*, which is attached to the clamping members *E* by means of the U-bolts *B*. Grooves are provided at the top and bottom *G* of the clamping members for the insertion of arcing horns or rods. The illustration shows the arcing rod *F* placed at the top, where it is ordinarily used. In order to prevent destruction of the clamp or cable by a flash-over the arcing horn is electrically connected to the cable by means of the aluminum strip *C*. The screws *D* are for the purpose of facilitating the assembly of the clamp on the line as they prevent the members from dropping apart. The clamp is pivoted at *A* so that breaking of the conductor will allow the clamp to swing, thus preventing kinking of the conductor. The clamp is somewhat more expensive to produce than some other designs, but the results in service seem abundantly to justify the expenditure.

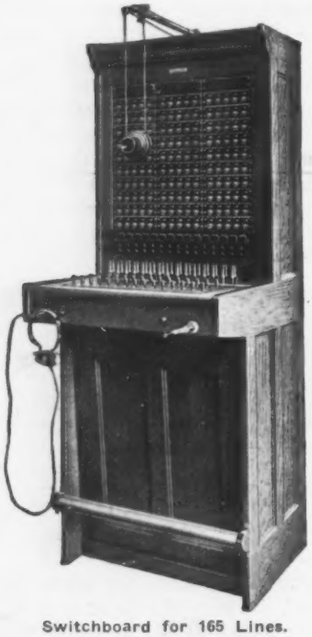
Mr. Willson has made arrangements with the Ohio Brass Company, of Mansfield Ohio, to manufacture and market this clamp.



Various Methods of Grounding Transformer Secondaries.

CONVERTIBLE TELEPHONE SWITCHBOARDS.

The telephone switchboard here illustrated has been designed for use by small telephone companies. The type is known as the magneto convertible non-multiple switchboard, being so arranged that it can be used originally for magneto service and then converted at will for central-battery operation. Oftentimes it is advantageous to make the change from magneto to central battery gradually. The switchboard here shown allows both kinds of service at the same time. One or more sections equipped for magneto service can be installed, and when the time comes for changing to central-battery operation the transition can be made without any loss of equipment.



Switchboard for 165 Lines.

The switchboards are made in two sizes, one arranged for 330 magneto or common-battery lines, thirty pairs of cords and thirty transfer circuits, and the other for 165 magneto or common-battery lines, fifteen pairs of cords and fifteen transfer circuits. They are so designed and constructed that any number of sections can be readily lined up together, so as to make a switchboard with several positions without making a single change in the woodwork of the cabinet, and the sections when so arranged present the appearance of one continuous cabinet. They have been developed for the market by the Western Electric Company.

GAS-ELECTRIC CAR.

The General Electric Company has just delivered a gas-electric car to the Buffalo, Rochester & Pittsburgh Railway. On April 18 the car proceeded to its destination over the lines of the New York Central Railroad with a party aboard consisting of Mr. William K. Vanderbilt, Jr., Mr. Harold Vanderbilt, Mr. A. H. Smith, Mr. P. E. Crowley, Mr. Horace E. Andrews, Mr. Edward F. Peck, Mr. J. R. Lovejoy, Mr. E. W. Rice, Jr., Mr. W. B. Potter, Mr. Arthur W. Jones, Mr. Henri G. Chatain and Mr. Frank E. Case. Owing to the absence of smoke, cinders and gas the passengers enjoyed the advantages of electric-railway travel in addition to the comforts of Pullman service.

This type of car is well adapted for use on branch lines which at present may be operated at a loss by steam and where the amount of traffic does not warrant electrification, and its use on such lines will reduce operating expenses and increase traffic.

The car is 66 ft. long, 14 ft. high and has a seating capacity of forty-nine in the passenger compartment and twenty in the smoking compartment, with two passengers per seat. The seats are sufficiently wide to accommodate three persons, and hence, if desired, the passenger compartment will accommodate sixty-nine and the smoking compartment twenty-eight, the total then being ninety-seven.

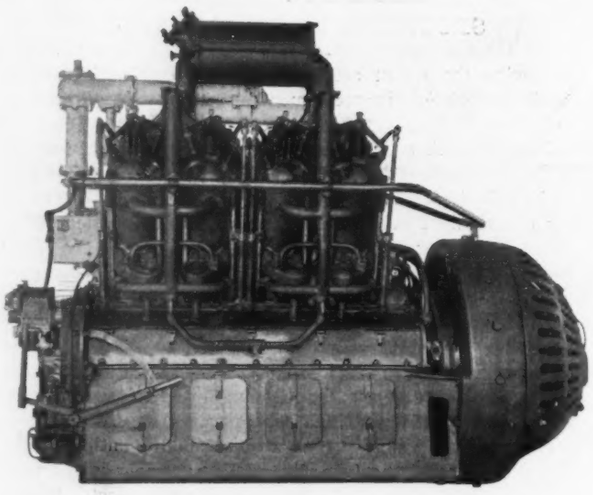


Fig. 2—Gasoline-Engine Set.

The car derives its power from a gasoline engine and transmits it to the wheels by means of an electric drive, thus avoiding any direct mechanical gearing or connection between the engine and the wheels. The engine is directly coupled to an electric generator, forming a compact power plant located in the engine compartment. The motors are of the standard railway type mounted upon the axles. The car is operated by means of a suitable controller in a manner similar to ordinary electric-trolley cars. A 100-gal. storage tank supplies sufficient gasoline to carry the car over 200 miles.

The car is provided with automatic and straight air-brake equipments and auxiliary hand brake for use in case of emergencies. It is also equipped with standard automatic air signals.

The car made the trip of 244 miles from Schenectady to Rochester by way of the Auburn division without delay of any kind. The smoothness of operation and ease of control were subjects of most favorable comment, and the speed attained on the heavy grades of the Auburn road was satisfactory in the highest degree.

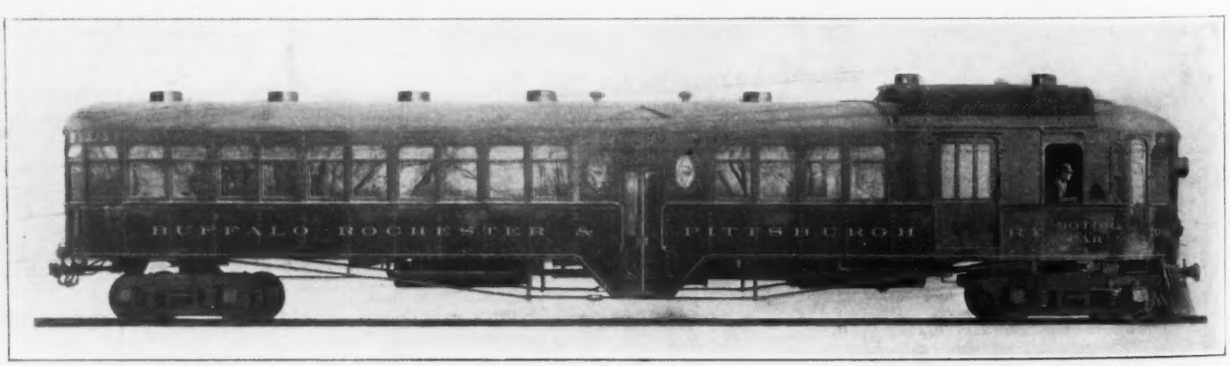


Fig. 1—Gas-Electric Motor Car.

SERIES INCANDESCENT LAMP SOCKET.

The series socket illustrated herewith has been especially designed for use with tungsten-filament lamps, although any type of lamp can be used. The "push-in" feature of the series socket used in the past has been entirely eliminated, thereby avoiding the breakage of the filament when putting the lamp in. This has been accomplished by arranging the socket to

Incandescent Lamp Socket.

screw into the receptacle, instead of pushing in. The socket carries a cut-out which operates in case the lamp burns out or is broken, and the receptacle is arranged with a short-circuiting device which automatically closes the line when the socket is removed. The socket is so designed that it can be used with all types of fixtures now in use. It is made by the Philadelphia Electrical & Manufacturing Company, 1228 North Thirty-first Street, Philadelphia.

THREE-PHASE TRANSFORMER OF 10,000-KVA RATING.

The Pennsylvania Water & Power Company generates power from the Susquehanna River at McCall's Ferry, where it will have an ultimate rating estimated at 100,000 hp, as noted in our issue for Oct. 20, 1910. At present the energy generated is transmitted 40 miles to Baltimore and transmission lines to other cities are contemplated.

The Baltimore substation is at present equipped for 40,000 kva and space is provided for additional transforming and switching apparatus. The present equipment consists of four 10,000-kva, three-phase transformers, which, because they are the largest transformers ever built, are of particular interest. They are of the water-cooled type and are used to step down the 25-cycle emf from 70,000 volts to 13,200 volts for distribution.

The appearance of one of these transformers is shown in the illustrations, but these do not give an adequate idea of their size. The tank is elliptical, having an over-all length of 15 ft. 11 in. and an over-all width of 8 ft. 8 in. The height to the top of the terminal is over 16 ft., and the joint between case and cover is 11.5 ft. from the floor. The total weight of each transformer complete with oil is about 145,000 lb., or nearly 75 tons.

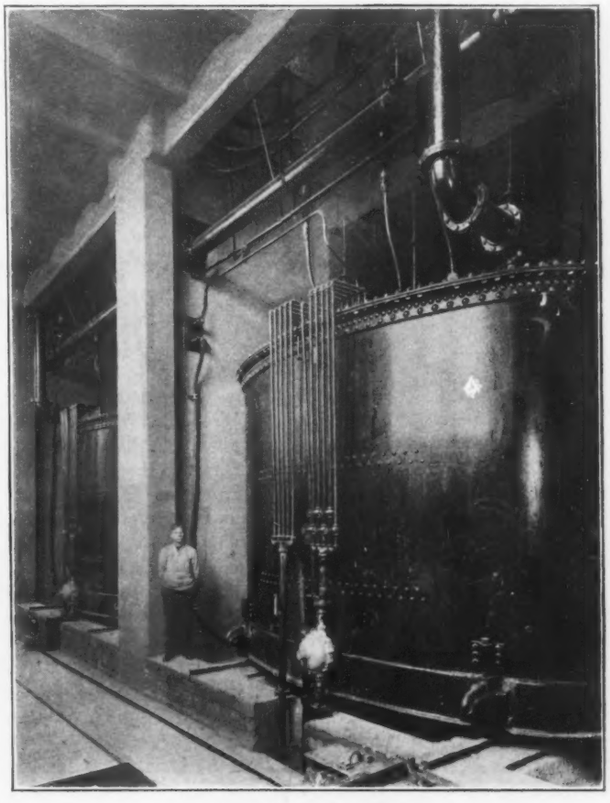
The transformers are of the core type, water-cooled. The cooling water is visible at its exit, so that any stoppage or inequality of flow in the parallel cooling coils can be detected easily. The tanks are of boiler iron with welded seams and crowned cover and bottom.

The condenser type of terminal bushing is used, as the specifications called for bushings to withstand a test of 180,000 volts for one minute. These bushings are made up of alternate layers of insulating and conducting material which, by producing a uniform distribution of dielectric stress in the insulation, enable the use of the minimum of material.

The method used in installing these large transformers is also of interest. On account of railroad clearances and the great weight of each unit, the core and coils, the tank, cover, base and details, and the oil were received from the factory separately. At the Baltimore substation a railroad siding runs directly into the station. Paralleling the siding in the station are the transformer compartments, built of concrete. On receipt of the transformers in the substation it was necessary to assemble them, one at a time, on a truck running on a track having the same center line as the siding, but wider gage. Lifting and moving were done with an electric hoist. After each transformer was assembled the truck was pushed along its track to the proper compartment, and the transformer rolled in on its own wheels, the floor of the compartments being at the level of the rails on the truck. The oil, received in tank cars, was pumped into the tanks after the transformers had been thoroughly dried out.

Underneath each transformer is a pit connected with a 10-in. main for draining the tanks in case of emergency. The top of each transformer is connected through a back-pressure valve to an 8-in. main to relieve any possible rise of pressure in a tank. The arrangement is such that oil blown out of one transformer cannot enter another.

The cooling system is arranged to preclude a shut-down from lack of cooling water. Normally water is obtained from a well near the substation. Connection is also made to the city mains for use in case of deficiency of the well, and a large storage tank on a steel tower, erected outside the substation, is built for use in case of failure of both sources. In



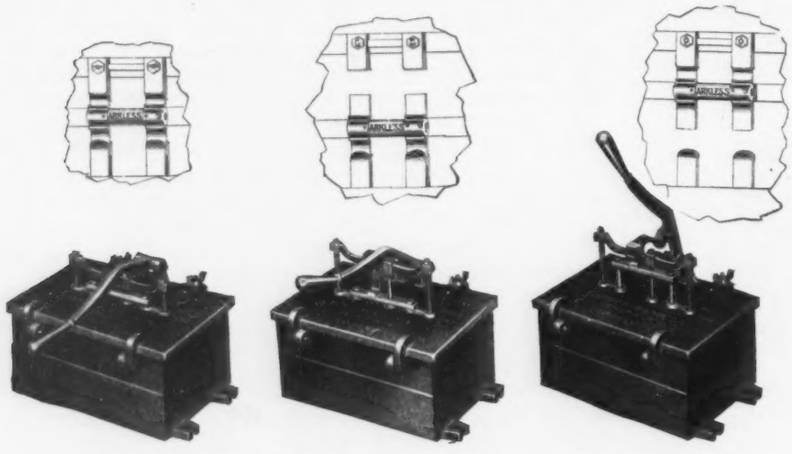
10,000-kva Transformers.

connection with this emergency system there is a spray cooling system, which makes it possible to re-use the cooling water, the storage tank supplying only the deficiency caused by leakage and evaporation. Normally the heated water is discharged into a nearby stream.

The transformers were furnished by the Westinghouse Electric & Manufacturing Company, and were built at East Pittsburgh, Pa.

MOTOR STARTER WITH FUSING DEVICE.

The three-phase motor starter here illustrated is arranged to take care of the heavy starting current by paralleling the fuses and to fuse the circuits properly for the running load. When throwing on the switch the fuses are paralleled by a copper bar as is noted in the small sketch of Fig. 1. It is necessary to hold this lever down until the motor has reached speed, at which time by removing the hand the lever is automatically thrown out and the paralleling device removed from circuit. This leaves the fuses protecting the motor, as is noted in Fig. 2. When it is desired to throw off the switch it is necessary merely to pull out the lever, as is noted in Fig. 3. The switch is "quick make" and "quick brake" with no intermediate position, and can be operated successfully by the most ignorant workman—that is, it is "foolproof." It has been placed on the market by the Detroit Fuse & Manufacturing Company, Detroit, Mich.

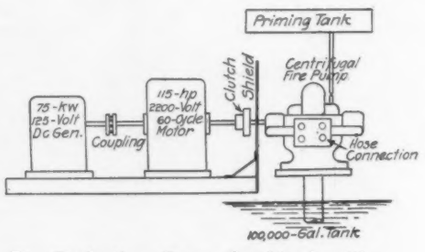


Figs. 1, 2 and 3—Starting, Running and Off Position of Switch.

FIRE PUMP COMBINED WITH MOTOR-GENERATOR SET.

For operating direct-current motors driving machine tools in its shops at Erie, Pa., from the alternating-current primary distribution lines of the Erie County Electric Company, the Burke Electric Company has installed a 115-hp motor-generator set, comprising a 2200-volt, 60-cycle, three-phase motor driving at 1120 r.p.m. through a flexible coupling a 75-kw, 125-volt direct-current generator. The motor element of this set in addition provides auxiliary fire protection for the 60,000 sq. ft. of buildings in the group. For this purpose the opposite end of the motor shaft is fitted with a clutch which when engaged drives a Dayton double-discharge centrifugal pump capable of delivering 1200 gal. of water per minute from a 100,000-gal. concrete-lined tank outside the buildings. A priming tank, always kept filled, is mounted just over the pump, so that putting the unit into service is simply a matter of opening the direct-current generator switch, closing the clutch and opening the priming valve.

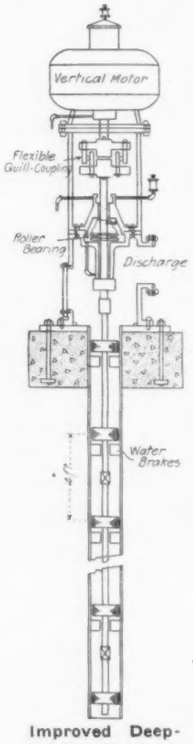
Inasmuch as the motor element is kept in continuous service, running almost constantly throughout the day, there can be little possibility of this unit failing to respond when called upon for emergency use. The centrifugal pump is equipped with a four-nozzle header, producing a nozzle pressure of about 80 lb. when delivering to four lines of 2-in. hose, or 110 lb. when delivering to one nozzle. The pump delivery line is also arranged for connection to the city water mains and to the automatic sprinkler apparatus in case of any impairment of city service. In spite of the virtually continuous test to which the motor is put, the pump element is started up frequently to make sure that all parts are in order. The water mains and sprinkler lines with which the buildings of the Burke factory group are fitted are provided with accessible valves so that by the proper arrangement of these any building can be supplied with water, over one of two or more routes, from the motor-driven centrifugal fire pump described.



Fire-Protection Pump Combined with Motor-Generator Set.

DEEP-WELL PUMP.

The improved form of deep-well pump shown in the accompanying sketch is adapted for depths up to 150 ft. where necessary, although operated to best advantage at depths of 80 ft. and less, where it is declared to show high hydraulic efficiencies. An 8-in. pipe is first sunk, forming the casing of the well. In this there revolves at 1200 r.p.m. the steel shaft shown, carrying impeller lifts at 4-ft. intervals. These impeller screws are inclosed in cylindrical casings which bear against the well pipe, being water-lubricated. Just before the water reaches each impeller screw it has its churning, whirling motion arrested by the pairs of water-brakes shown. These brakes enable the next pair of impellers to react on and lift the water, as would be otherwise impossible were the water rotating nearly as fast as the screws themselves. The entire shaft with its runners is carried on a roller bearing with self-oiling bronze bushings. The motor drives the shaft through a unique flexible coupling comprising two opposing quills of steel fingers interwoven by a leather belt through which the driving action is exerted. The well shaft is itself flexible to adapt itself to errors of alignment in the well boring.



Improved Deep-Well Pump.

One of these pumps at Oklahoma City, Okla., in the plant of the local electric company is delivering 450 gal. per minute from an 8-in. well, 40 ft. deep, and has made unnecessary the drilling of additional wells which were first thought to be needed. Another similar pump, at Wichita, Kan., is said to be raising 750 gal. per minute from a 38-ft. well at an expenditure of 13 kw at the motor. This deep-well pump was devised and is being manufactured by Mr. W. S. Gregg, a consulting engineer of Kansas City, Mo.

Industrial and Commercial News

THE WEEK IN TRADE.

OWING to a tendency toward price concessions, a more hopeful view is taken of prospects for an early movement in general trade, and although a definite basis seems lacking, there is a belief that the situation has been slightly improved during the week. Retail trade has benefited by good weather and banks are exchanging more outside checks than in the early part of the month. With the volume of April business less than that of March and February, further disappointment was found in the Steel Corporation's report, which is considered an indication of the state of general trade. Net earnings were greatly under expectations, in addition to being the smallest in all but nine quarterly periods in the history of the company. With the light demand for iron ore, as shown in the reduction in price of the lake ores, and with the light demand for grain, the soft coal trade having an outlet on the lakes is threatened with a tie-up, since shipping interests with no grain or ore to carry south are not disposed to offer facilities to coal operators for transporting their product. A fair volume of business is being done in necessities and the activity abroad continues to help the export trade. The exports from New York for the week amounted to $20,044,484, which is an increase of $6,502,755 over the figures for this period in 1910. Imports were $16,908,701, showing nearly $1,500,000 less than for the same week last year. Stock markets have been irregular, and only a small amount of business has been transacted. Bond markets have been active and a fair amount of money has found its way into investment securities, while prices are slightly better. Advices from farming sections give no cause for concern in the outlook for crops, grain, winter wheat and fruit reports continuing to be favorable, and while the weather in the cotton districts has not been so warm or dry as might be desired, the crop is expected to be larger than that of last year. Collections are slow to fair. Business failures for the week ended April 27, as reported by *Bradstreet's*, were 240, as compared with 233 for the previous week, 189 for the same week in 1910, 268 in 1909, 282 in 1908, and 163 in 1907.

THE COPPER MARKET.

EVENTS of the week indicate manipulation in the trade, and excepting for one large sale of some 15,000,000 lb. to brass interests at approximately 12⅛ cents at ninety days, the net changes in the situation are unimportant. There is but little action on the part of buyers in any lines, demand from domestic consumers is light, and there are indications that the majority of lines are well supplied for May and June, at least. Demand abroad has been slightly increased, with a small advance in standard copper, but the activity was only temporary, the market showing a decline at the end of the week. There seems to be a well-defined impression that the United Metals company will abandon its policy of making fixed prices, thus placing the copper trade on a competitive plane, but inasmuch as price cutting by Amalgamated interests can be easily met by competitors who have a lower cost of production, there would seem to be no logical basis for such action on the part of the Amalgamated company, except for moving present stock. Rational curtailment on the part of the big producers would assist the situation. In view of light demand producers cannot afford to stand expenses of production indefinitely, so that unless early change occurs in the situation enforced curtailment may follow. Heavy imports have been a feature of the week, making totals for the month nearly 15,000 tons. March imports, as given by the government report, were 13,500 tons and total imports for the first quarter of the year were 37,500 tons, an increase of 2500 tons over the figures for the first quarter last year. Exports for the month were 27,466 tons. The daily call on the Metal Exchange May 1 quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.60	11.70	.....
April	11.60	11.70	11.65
May	11.65	11.75	11.70
June	11.65	11.75	11.70
July	11.65	11.75	11.70

The London market, May 1, was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	54 1 3	54 12 6
Standard copper, futures	54 1 3	54 13 9

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.30c	11.65c
London, spot	£56 15 0	£53 11 3
London, futures	57 12 6	54 3 9
Best selected	60 5 0	57 5 0

INDUSTRIAL AND COMMERCIAL NOTES.

Georgia Power Company.—C. O. Lentz, chief engineer of the Georgia Power Company, says that rapid progress is being made in the construction of the development of the company at Tallulah Falls, and that bids for equipment will be received up to the end of this week at the office of the Northern Contracting Company, New York. The specifications for the first instalment at Tallulah Falls call for the following: (a) Three 10,000-kva, 60-cycle, 6660-volt, three-phase, water-wheel type alternators; (b) nine 3333-kva, single-phase, water and oil-cooled transformers; (c) one 20,000-kw, 110,000-volt, three-phase, outgoing line equipment; (d) two 300-kw, direct-current, 250-volt exciter generators, for direct connection to two reaction water-wheels, also for direct connection to a 450-hp induction motor, the water-wheels, both exciters and the induction motor to be mounted on a common bedplate; (e) one 450-hp induction motor for direct connection to both exciters. The ultimate capacity of the station will be six units of item (a), nineteen units of item (b), four units of item (c), two units of item (d) and one unit of item (e). Contracts for the towers for the 230-mile transmission line have been let to the American Bridge Company, together with the steel work required in the construction of the station. The American Steel & Wire Company has been awarded a contract for 2,000,000 lb. of wire for the transmission line. Part of the insulators for the circuit between Tallulah Falls and Atlanta, the outer zone of which will be reached by the lines now building, will be furnished by Thomas & Sons Company, of New York, and the balance by the Ohio Brass Company. It is expected that the first instalment will be in operation within a year and a half.

Electrical Equipment for Pittsburgh Steel Mill.—Dilworth, Porter & Company, Ltd., a Pittsburgh steel manufacturing concern which is enlarging its mill, will install electric drive and has ordered from the General Electric Company one 1500-kva mixed pressure turbine, which will run from the company's present rolling-mill engines. In addition to this unit the company will also install one 25-kw turbo-exciter, one 700-hp, one 350-hp and six 7-hp mill motors, two 20-hp totally inclosed motors, two 75-hp vertical motors, and three 40-kw transformers, together with switchboard, controlling apparatus, etc., all of which will be furnished by the General Electric Company. The 700-hp motor is to be connected by rope drive to an 18-in. mill and the 350-hp motor will be directly connected to a spike rod mill, the 20-hp motor driving the bull heads for the same. The 7-hp motors are of the reversing mill type and will drive tables, cooling beds, etc., while the vertical motors will drive pumps for supplying condensing water for the turbine, as well as water for general use around the mill. Low-tension current for the 20-hp and 7-hp motors will be supplied by the small transformers. A recording wattmeter with transfer switch mounted on the power-station switchboard will enable a record to be made of the operation of either of the large motors.

Dams on the St. Lawrence River.—The Canadian Light & Power Company is planning an expenditure in the neighborhood of $15,000,000 for building a large station in addition to construction now going on at the foot of the Beauharnois Canal and has applied to the Dominion government at Ottawa for authority to build dams across the St. Lawrence River near Coteau, at the head of the rapids. All of the projected work will be situated in Canadian territory.

Westinghouse, Church, Kerr & Company.—Among recent plants installed by Westinghouse, Church, Kerr & Company is a 600-kw gas producer plant for the estate of the late E. H. Harriman, at Arden, N. Y. The equipment consists of three 200-kva Westinghouse generators and a gas producer set furnished by the same company. Three producers have been installed to date, and provision has been made for an ultimate plant rating of 1000 kw. In addition to supplying energy for the needs of the Harriman estate the plant will furnish lighting service in the immediate neighborhood, and also to the residential district at Tuxedo Park. Westinghouse, Church, Kerr & Company have also finished work on the plant of the Worcester Electric Light Company, Worcester, Mass., 6000-kw equipment in turbines having been installed, with provision made for an additional 2000-kw unit in the future. The building and stack are of reinforced concrete. The plant will operate condensing, and is equipped with Sterling boilers and Taylor stokers. The additions to the plant of the Hartford Electric Light Company, on which these engineers have been busy since 1904, have been completed, and two additional 4000-kw General Electric horizontal-type turbines, with additional switchboard and boiler equipment, have been installed. The installation of these two 4000-kw units makes the nominal rating of the plant at present 21,000 hp.

Telephone Train Dispatching.—The Central Vermont Railway has installed a system of train dispatching telephones between St. Albans and Windsor, Vt., with a branch from Montpelier Junction to Williamstown, a distance of 150 miles. Selectors and telephone sets have been installed at each of the thirty-eight way stations on the division, the Van Akin telephone arm being used by the way-station operators. The Chicago, Milwaukee & Puget Sound Railroad Company will also be using the telephone very shortly to dispatch its trains between Mobridge, S. D., and Deer Lodge, Mont., a distance of 755 miles, and an order has been placed by the company for seventy-five sets of telephone equipment. The Pennsylvania Railroad, which is already operating a number of its divisions with telephone equipment, as recently mentioned, has just placed an order for telephone equipment for use on its Bellwood division. All the telephone equipment used on these roads was ordered from the Western Electric Company.

Storage Battery Cars on Salisbury & Spencer Railway.—A demonstration of the storage battery car was made last week by the Federal Storage Battery Car Company upon the system of the Salisbury & Spencer Railway system, control of which has been acquired by W. J. Oliver, as mentioned in our issue of April 13. The test was made on the line between Concord and Salisbury, N. C., and was witnessed by officials of many Southern railroad, central station and manufacturing interests, who expressed themselves as favorably impressed with the performance of the car. Le Roy Scott, sales manager of the Federal company, who conducted the test, states that with fifty-two passengers the energy consumed in a 4-mile trip over grades from 1.2 per cent to 6.8 per cent was 1.8 kw-hours, averaging 0.450 kw-hours per car-mile. Mr. Scott advises that the Salisbury & Spencer officials intend to install a number of these cars upon the system.

Southern Power Company.—The Harris Trust & Savings Bank, of Chicago, is offering for sale $1,000,000 of first-mortgage 5 per cent gold bonds of the Southern Power Company. The Southern Power Company owns and controls modern hydroelectric plants having a rating of about 108,000 hp. This equipment will soon be increased to 130,800 hp and will furnish electrical energy to the southern cotton mill district of North Carolina and South Carolina, including the cities of Charlotte, Greensboro, Winston-Salem, Salisbury, Spartanburg and Greenville. The territory served has a population of about 600,000. In addition to supplying electricity to more than 100 cotton mills, the company supplies energy at wholesale to a number of local distributing companies. J. B. Duke is president of the company. In the year 1910 the gross earnings of the company were $1,263,479 and the net earnings $807,937. The bonds run for twenty years, from March 1, 1910. They are offered at par and accrued interest.

Large Arc-Lamp Order from Cincinnati.—The Union Gas & Electric Company, of Cincinnati, has placed with the General Electric Company what is said to be the largest single order for arc lamps ever received by a manufacturer. This order calls for 6000 of the company's latest type series luminous-arc lamps, including a complete mercury-arc rectifier station equipment for 9000 lamps. The order, twice as large as any previous lamp order, and reaching a total value close to half a million dollars, is significant of the rapidly increasing popularity of this type of lamp. When the 6000 new lamps are installed in Cincinnati the city will rank in illumination with Boston, St. Louis, Toledo, Montreal and Baltimore, which use the same type of lamp and are considered among the best lighted cities on this continent.

Electric Flatiron Contracts.—The recent order received by the General Electric Company from H. M. Byllesby & Company for 5004 electric irons, as mentioned in the issue of April 6, and the order of the Southern California Edison Company, of Los Angeles, for 6000 similar irons, are indicative of the commercial status of the electric flatiron and of the attitude of the larger central station companies in placing orders. Heretofore orders have usually been in lots of a few hundred, the supply being replenished at frequent intervals during the flatiron season, this method involving risk of delay in the midst of a campaign. The present practice is to estimate early in the year the requirements for a season's campaign, placing contracts in sufficient time to insure having a full stock on hand when required.

Blewitt Falls Transmission Line to Be Started.—President Charles E. Johnson, of the Yadkin River Power Company, says that no time will be lost in completing the new plant of the company at Blewitt Falls, on the Pee Dee River, Richmond County, N. C., and in the construction of the large transformer station near Raleigh. The Phoenix Construction Company, which has the contract for building the transmission line, has opened an office in Raleigh in preparation for the work. The line will extend from the plant to Raleigh and to towns in the vicinity, including Louisburg, Henderson and Wake Forest to the north and as far as Goldsboro to the east. The plant was started by the Rockingham Power Company, as described in the *Electrical World* March 23 and April 20, 1911.

Westinghouse Traction Equipment Sales.—The Metropolitan Street Railway Company, of Kansas City, Mo., has placed an order with the Westinghouse Electric & Manufacturing Company for 100 street railway motors. This is additional to an order for 200 motors placed last year by the Metropolitan with the Westinghouse company. The Sioux City Service Company has recently ordered a large number of modern interpole motors of 30 hp each to replace all old types of motors now in service. Foreign business secured by the Westinghouse company during the last week includes orders from the San Juan Traction Company, of Porto Rico, and the Rio de Janeiro Tramway, Light & Power Company, Rio de Janeiro.

New England Lines Industrial Bureau.—President C. S. Mellen of the New York, New Haven & Hartford Railroad and representatives of the Boston & Maine and Maine Central Railroads have completed plans for the formation of the New England Lines Industrial Bureau, which is to be opened in Boston in May. The purpose of the bureau is to further development in all forms of New England industry, especially in farming, dairy and manufacturing lines, by co-operation between the railroads and industrial interests. William H. Seely, general freight and passenger agent of the Central New England Railroad, is to be head of the bureau.

Clarion River Power Company.—The State Water Supply Commission at Harrisburg, Pa., has heard protests during the week against the granting of charters to the Clarion River Power Company and others, who are planning to build dams and stations on the Clarion River, as outlined in the issue of April 20. Representatives of business and residential interests were present and were active in opposing the approval of the charters.

New Unit for Columbia Electric Street Railway, Light & Power Company.—Messrs. J. G. White & Company, of New York, have purchased a 2500-kw turbo-generator from the General Electric Company for the plant of the Columbia Electric Street Railway, Light & Power Company, Columbia, S. C. Babcock & Wilcox boilers will be installed to furnish the additional steam requirements.

Bulletins Wanted.—Walter L. Hibbard, who is conducting an electrical engineering, contracting, supply and general machinery business at Fitchburg, Mass., wishes to receive catalogs, bulletins and other descriptive matter pertaining to equipment in these various lines.

Financial.

THE WEEK IN WALL STREET.

REVIVAL of interest in the bond market, with investment securities finding a ready sale at advanced prices, is probably the chief feature of note in New York markets. This activity has been a source of considerable comment, inasmuch as an active bond market usually imparts a corresponding tone to stock transactions. The belief has, therefore, been freely expressed that the long-awaited impetus has been given to the market. There is, however, an abundance of evidence at hand to favor the view that the briskness in bond sales is due rather to the absence of speculative interest and more to the fact that conservative investment is being sought for the excess of idle funds. The week's transactions in stocks were slightly in excess of those of the previous week, the shares sold amounting to 1,725,941, compared with 1,692,933, as reported for the week preceding. In the earlier part of the week trading was irregular, with the general trend of prices toward a higher level, while near the end of the week the activity was more marked, a number of issues gaining a point, and in some cases even a fraction in excess of this. While more interest was evidenced during the week than in several weeks past the trading was, in the main, of professional character. Current matters exerting an influence on the market included the small earnings of the Steel Corporation for the first quarter of the year, the postponement of rulings in the trust cases, the advances in cotton prices to the top level of the year and the status of the Mexican revolts. The record for April is the lowest since August, 1900, sales at that time aggregating 3,949,000, against 4,706,000 for the month just closed. Such improvements as may come in the state of general trade will be gradual, and the present season of the year, at best, is not one to accelerate a change. With announcement of the decisions, settlement of tariff revision and fulfilment of expectations for large returns from the farming districts, it would seem likely that conditions would show improvement. Money continues to be easy, rates May 1 being: Call, 2@2½ per cent; ninety days, 2½@2¾ per cent. The quotations in the table are those of the close May 1.

NEW YORK.

	April 24.	May 1.	Shares Sold.		April 24.	May 1.	Shares Sold.
All. Ch.....	7⅜*	7½*	100	Int. Met., pf.	49½	51⅞	6,900
Al. Ch., pf..	26	28	400	Mackay Cos..	93½*	90½*	100
Amal. Cop..	63	63⅞	90,550	Mackay C.,pf.	74⅞*	74⅞*	———
Am. D. T...	20½*	20½*	———	Man. Elev....137		136*	525
Am. Loco...	35¾*	38	400	Met. St. Ry.	15*	15*	———
Am. Loco. pf.	104	104⅞*	110	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	83*	83*	———	Steel, com....	73⅞	76¾	438,180
Am. T. & T..	145	146½	3,610	Steel, pfd...	119	119¼	8,717
B. R. T....	76⅞	79⅛	16,853	W. U. T....	72*	73¾	1,310
Gen. Elec....	150½	159	13,400	West'h, com..	65	69	6,200
Int. Met....	17½	18¼	4,600	West'h, pfd..	117*	117½	400

PHILADELPHIA.

	April 24.	May 1.		April 24.	May 1.
Am. Rys.....	44	44	Phila. Elec.....	16¼	16½
Elec. Co. of A.....	11⅞	12*	Phila. R. T.....	17⅛	18
Elec. St. B'ty.....	52	52¾	Phila. Trac.....	82½*	82¼
Elec. St. B'ty., pfd..	30*	30*	Union Trac.....	45⅛	46

CHICAGO.

	April 24.	May 1.		April 24.	May 1.
Chi. City Ry.....	186*	186*	Chi. Tel. Co.....	122*	121
Chi. Rs., Ser. 1.....	85*	80*	Met. El. Co.....	22⅛*	22⅛*
Chi. Rs., Ser. 2.....	22	22*	Met. El., pfd.....	67*	67*
Com. Edison.....	125⅜	125	Nat'l Car.....	115*	114*
Chi. Subways.....	5	5¼	Nat'l Car, pfd.....	120*	120*

BOSTON.

	April 24.	May 1.		April 24.	May 1.
Am. T. & T.....	145	146½	Mex. Tel.....	3½*	4¼
Cum. Tel.....	150	150*	Mex. Tel., pfd.....	6½*	6½*
Edison E., Ill.....	285¼*	286*	N. E. Tel.....	141	142¾
Gen. Elec.....	151½	158	W. T. & T.....	18*	19½
Mass. E. Ry.....	16	18¾	W. T. & T., pfd....	94*	94
Mass. E. Ry., pfd....	87	88			

*Last price quoted.
Shares sold for week, April 24 to April 29.

FINANCIAL NOTES

United Gas Improvement Company's Report for 1910.—The total income of the United Gas Improvement Company for the year ended Dec. 31, 1910, was $8,159,530, an increase of $510,295 over the previous year. The total expenses were $1,080,477, leaving net profits of $7,079,053, an increase of $422,944 over this item for the previous year. After deducting $725,500 which was applied to the sinking funds, there was left a balance for dividends of $6,353,553, from which dividends amounting to $4,338,872 were paid. The surplus for the year was $2,014,681, showing a falling off of $158,556 from the surplus in 1909. The total surplus of the company is given as $25,625,098. President Thomas Nolan reviews a number of the financial transactions of the year and says in part: "In February, 1910, we purchased more than a majority of the stock of the Conshohocken Gas Light Company, West Conshohocken Gas Light Company and Conshohocken Electric Light & Power Company, and forty-two acres of land on the Schuylkill River, near West Conshohocken, with the idea that when the business of the Merion and Radnor Gas & Electric Company outgrows the capacity of the present plant at Ardmore these companies should be consolidated with the Merion & Radnor Gas & Electric Company and a new plant built on the new site. In the summer of 1910 was acquired more than a majority of the stock of the Northern Indiana Gas & Electric Company, and in January, 1911, was completed the merger into that company of the South Bend & Mishawaka Gas Company and the Plymouth Lighting Company. We believe that there is a great future for business, particularly for electricity for power purposes, in the territory of this company, which is destined to become one of the great industrial centers of the United States, including as it does the district from Chicago to Gary, as well as the flourishing cities of Michigan City, South Bend, Mishawaka and Plymouth."

American Telephone & Telegraph Company.—In keeping with the progress made each year, as noted in these columns from time to time, the statement of earnings of the American Telephone & Telegraph Company for three months ended March 31 shows the total revenue from all sources to be $9,111,294, representing an increase of $221,943 over this item for the first quarter of the previous year. The amount deducted from this for expenses was only $842,497, leaving net earnings of $8,268,797. The ratio between total revenue and expenses is proof of efficient management and economical operation. When interest charges were deducted there was left a balance of $6,834,475, from which dividends of $5,095,218 were paid, the difference being carried to reserve funds or to profit and loss. The balance available for dividends represents 2.59 per cent on the $263,335,600 outstanding capital stock, compared with 2.66 on the $256,475,300 stock outstanding for the corresponding period of 1910. This quarterly per cent is at the rate of 10.36 per cent yearly on the present outstanding stock. The revenues of the company have shown remarkable increase in the past eleven years, the total net earnings in that time available for dividends amounting to $152,907,334, of which 75.45 has been paid to stockholders and the balance applied to reserve funds.

Augusta-Aiken Railway & Electric Corporation Bonds.—Redmond & Company, of New York and Philadelphia, are offering $2,400,000 5 per cent sinking-fund gold bonds of the Augusta-Aiken Railway & Electric Corporation at 94 and accrued interest, paying about 5.5 per cent. These are due Dec. 1, 1935, and will be secured by a direct first mortgage on the entire railway and lighting properties, subject only on a part thereof to an issue now limited to $967,000 and which is annually being reduced. A gradually increasing sinking fund, beginning in 1916, it is estimated, will retire over $1,300,000 of these bonds by maturity. The Augusta-Aiken company controls and operates the entire street-railway and electric-lighting system of Augusta, Ga., and its suburbs, together with the railway to Aiken, S. C. Gross earnings of the company for the year 1910 were $614,031 and operating expenses $335,748, leaving net earnings of $278,283, from which, after deducting charges, was left a surplus of $103,283.

Improvement in South American Utilities.—Both the Rio de Janeiro Tramway, Light & Power Company, Limited, and the Sao Paulo Tramway, Light & Power Company report increases in returns for 1910. Gross earnings of the Rio de Janeiro company increased about $3,400,000 and net earnings were some $2,325,000 larger than in the previous year. Electrification of the various lines of the company was completed during the year and the large increase in the passengers carried is attributed to this. Telephone, lighting and traction properties are reported in satisfactory condition. An addition of 83,000 incandescent lamps was made to the system, the number of arc lamps increased 3075 and the connected load in motors was also largely increased. Increase was made by the Sao Paulo company, some 12,000 lamps being added to the system, and corresponding additions were made to the motor service mains.

Telephone Extensions at Los Angeles.—The Sunset Telephone Company is making improvements and extensions costing about $75,000 on its lines between Los Angeles and Huntington Park. The Home Telephone Company is reported to be behind on its orders for service in Huntington Park.

St. Cloud Water Power Company.—In advertising for sale $250,000 of first-mortgage 6 per cent gold bonds of the St. Cloud Water Power Company, of St. Cloud, Minn., the Colonial Trust & Savings Bank, of Chicago, gives some interesting information about that company. The properties of the St. Cloud Water Power Company and the Union Power Company were consolidated under the former name on April 1. The combined net earnings of the two properties were $23,447 in 1910. The replacement value of the St. Cloud Company is largely in excess of the bonded debt, and in addition the company has valuable flowage and riparian rights on the Mississippi River. There is available at its power development site 3700 computed horse-power at low water. Messrs. J. G. White & Company, of New York, are the engineers for the company. The bonds are offered at par and accrued interest.

Interborough Rapid Transit Note Issue.—The proceeds of the $10,000,000 Interborough Rapid Transit Company's one-year 4.5 per cent notes, which have been sold to J. P. Morgan & Company, will be used to take up the $4,584,000 three-year 6 per cent notes which mature May 1, 1911. These three-year notes were part of an issue of $25,000,000 6 per cent convertibles which was originally made to retire $15,000,000 notes falling due in May, 1908, together with $6,250,173 promissory notes, and for payment of various obligations resulting from acquisition of property. Cost of equipment and construction is said to have exceeded $7,500,000 since May, 1908, and since that date payments have been made from current earnings. It is planned to use the balance of the new issue to reimburse the treasury for these expenditures.

Westchester Lighting Company Bonds.—Announcement is made that $2,481,000 additional first mortgage 5 per cent fifty-year gold bonds of the Westchester Lighting Company have been listed on the New York Stock Exchange, making the total listed and outstanding $8,397,000 out of $10,000,000 authorized. A portion of the $2,481,000 bonds amounting to $1,391,000 held in the treasury of the Westchester Lighting Company have been known as treasury bonds. The present issue of bonds and also all the bonds issued and to be issued under the first mortgage by resolution of the executive committee received the guarantee of the Consolidated Gas Company, which owns the Westchester company.

Chicago Consolidated Traction Company.—Judge Grosscup, of the United States Circuit Court, has entered an order discharging John M. Roach, David R. Forgan and A. L. Drum as receivers for the Chicago Consolidated Traction Company. The order, which was entered on April 21, will be made permanent unless adverse action is taken within thirty days. Mr. Roach was named as a special receiver without bond to meet claims. The receivers were appointed in June, 1908, and the property has since been sold and divided, the Chicago Railways Company acquiring the lines inside the city and the County Traction Company the lines in Cook County outside the city limits.

Oregon Interests Transferred.—The properties of the Klamath Falls Light & Water Company, of Klamath Falls, Ore., have been purchased by the Klamath Falls Power Company, the transaction involving about $500,000. The purchase includes two plants in Klamath Falls, the transmission lines throughout the city and those extending to several towns about 25 miles away. The company is said to be a subsidiary of the Siskiyou Electric Light & Power Company, of Yreka, Cal., which was recently denied a franchise for transmitting energy to Klamath from its station on the Klamath River, about 20 miles distant.

Santa Barbara Gas & Electric Company.—At a recent meeting of the directors of the Santa Barbara Gas & Electric Company it was decided to ask stockholders to ratify a bond issue of $1,000,000. The new bonds are to bear 6 per cent interest, the plan being to substitute them for the 5 per cent issue of the same amount which it has been found difficult to float. This plan will not increase the bonded indebtedness of the company, and will offer a more attractive bond to investors. At present $680,000 of the 5 per cent bonds are held as security for loans. The 5 per cent bonds will be called in as soon as the 6 per cent issue is placed on the market.

Missouri & Kansas Telephone Company.—In line with a large percentage of public utilities, the returns of the Missouri & Kansas Telephone Company for the year ended Dec. 31, 1910, showed a notable increase. Gross earnings were $3,182,397, compared with $2,859,161 for 1909, and net earnings were $681,242. While no dividends have been paid since 1906, the surplus for 1910 is $144,631, which compares favorably with a deficit of $315,247 in 1909. The company now has nearly 370,000 stations, which represents nearly three times the total in 1906, and development has increased nearly as rapidly in all branches of the company's interests.

La Crosse Water Power Company.—As previously noted in these columns, the La Crosse Water Power Company, of La Crosse, Wis., failed to meet its bond interest on April 1. Certain holders of the bonds have requested Fred Vogel, Jr., president of the First National Bank of Milwaukee; Frank O. Wetmore, vice-president of the First National Bank of Chicago, and Harrison B. Riley, president of the Chicago Title & Trust Company, to act as a bondholders' committee to investigate the affairs of the company and to take such steps for the protection of the owners of the bonds as they find desirable.

Western Maryland Telephone Company.—The Chesapeake & Potomac Telephone Company is making negotiations to acquire the capital stock of the Western Maryland Telephone Company, of Allegany County, amounting to $100,000. A petition has been filed by the Chesapeake company with the Public Service Commission stating that an option has been obtained on all the stock, the Chesapeake & Potomac Telephone Company agreeing to pay $40,000 in cash and $40,000 in the common stock of the American Telephone & Telegraph Company.

Altantic & Pacific Telegraph Meeting.—The following directors were elected at the annual meeting of the Atlantic & Pacific Telegraph Company: Theodore N. Vail, Newcomb Carlton, C. W. Atkins, A. R. Brewer, B. Brooks, Thomas F. Clark, George H. Fearons, E. J. Hall and J. B. Van Every. At the directors' meeting the following officers were elected for the ensuing year: President, Theodore N. Vail; vice-president, Thomas F. Clark; treasurer, A. R. Brewer; acting secretary, F. W. Lienau.

Western Gas & Electric Company to Redeem Notes.—The Fidelity Trust Company, of Philadelphia, has given notice that the Western Gas & Electric Company will redeem and pay all of its collateral trust notes dated Dec. 1, 1910, due June 1, 1915, at 101 and accrued interest, on June 1, 1911, at the Philadelphia office of the trust company.

DIVIDENDS.

Amalgamated Copper Company, quarterly, 50 cents per share, payable May 29.

Connecticut Railway & Light Company, quarterly, common, 1 per cent; preferred, 1 per cent; both payable May 15.

Montreal Light, Heat & Power Company, quarterly, 2 per cent, payable May 15.

National Carbon Company, quarterly, preferred, 1¾ per cent, payable May 15.

United States Steel Corporation, quarterly, common, 1¼ per cent, payable June 29; preferred, 1¾ per cent, payable May 29.

REPORTS OF EARNINGS.

Period.	Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
BIRMINGHAM RAILWAY, LIGHT & POWER COMPANY.					
March, 1911	$227,023	$117,007	$110,016	.....	.....
" 1910	214,798	113,912	100,886	.....	.....
CUMBERLAND TELEPHONE & TELEGRAPH COMPANY.					
March, 1911	$598,511	$349,744	$248,766	$50,644	$198,122
" 1910	568,336	320,729	247,607	47,523	200,083
MASSACHUSETTS ELECTRIC COMPANIES.					
Qtr. Mar., 1911	$1,830,361	$1,250,983	$579,378	$459,754	$119,624
" 1910	1,767,153	1,256,599	510,554	470,532	40,022
MONTREAL STREET RAILWAY COMPANY.					
March, 1911	$371,922	$234,484	$137,508	$46,423	$91,085
" 1910	336,197	220,790	115,407	40,675	74,731
NORTHERN OHIO TRACTION & LIGHT COMPANY.					
March, 1911	$190,186	$110,850	$79,336	$44,329	$35,007
" 1910	173,424	99,159	74,265	43,291	30,974
PHILADELPHIA COMPANY.					
March, 1911	$1,884,369	$1,084,509	$809,860	.....	.....
" 1910	1,916,662	974,350	942,312	.....	.....
ROCKFORD ELECTRIC COMPANY.					
March, 1911	$33,145	$19,636	$13,509	$6,742	$6,767
" 1910	29,255	18,216	11,039	5,395	5,643
SCRANTON ELECTRIC COMPANY.					
March, 1911	$60,305	$26,631	$33,674	$11,427	$22,247
" 1910	58,945	31,498	27,447	9,719	17,727
TWIN CITY RAILWAY & LIGHT COMPANY.					
March, 1911	$220,758	$127,574	$93,184	$66,518	$26,666
" 1910	198,777	113,315	85,462	62,238	23,224
UNITED RAILROADS OF SAN FRANCISCO.					
March, 1911	$657,176	$363,397	$293,779	.....	.....
" 1910	648,203	381,772	266,431	.....	.....
VIRGINIA RAILWAY & POWER COMPANY.					
March, 1911	$185,328	$100,062	$87,868	$55,058	$32,809
" 1910	173,127	79,649	96,143	54,935	41,207

General News

Construction News.

ATTALLA, ALA.—The Etowah Light & Power Company is reported to be preparing plans for extensions and improvements to its electric plant and water-works plants, to cost about $50,000. The company was recently granted a twenty-year franchise.

BIRMINGHAM, ALA.—The Senate has passed a bill giving the city of Birmingham power to acquire and operate its own electric-light and water-works systems.

FORT SMITH, ARK.—Negotiations are under way for the consolidation of the Pan Long-Distance Telephone Company, of Fort Smith; the Southern Telephone Company, of Fordyce, Ark., and the Kinloch Telephone Company, of Missouri, with Fort Smith as the central point. The Southern Telephone Company controls all of the independent systems in Arkansas and the eastern portion of Oklahoma, and has purchased the system of the Kizer Telephone Company, with exchanges at Mena and Ashdown, including an automatic system with double copper wire, costing about $300,000. The Southern company is now building a line from Little Rock to this city, and will connect with the Kinloch system at Fayetteville.

IMBODEN, ARK.—It is reported that George Dutton, of Imboden, has purchased the plant and holdings of the Imboden Light & Power Company.

ANAHEIM, CAL.—Sealed proposals will be received by the Board of Trustees at the office of the city clerk, Anaheim, Cal., until May 11 for furnishing and installing the following equipment at the municipal electric-light plant and water-works system: One compound automatic steam engine; one 150-kva, 220-volt, three-phase, 60-cycle, alternating-current generator; exciter for generator; one switchboard panel; building foundation and erecting engine and generator. Specifications may be obtained on application to Edward R. Merritt, city clerk, or to A. L. Lewis, superintendent of the municipal electric-light plant and water-works system.

BAKERSFIELD, CAL.—Announcement has been made by the San Joaquin Light & Power Company of a reduction of 25 per cent in the price of electricity for all purposes to take effect from July 1. The company expects to have its transmission lines completed from the new generating plant at Crane Valley into Bakersfield, which will enable the company to furnish the service at less cost than at present.

BURLINGAME, CAL.—Application has been made to the Board of Trustees for a fifty-year franchise to construct and operate an electric railway in the East District. Ansel H. Easton is interested in the project.

CLAREMONT, CAL.—The City Council has granted the Pacific Gas & Electric Company a franchise in this city for a term of fifty years.

HANFORD, CAL.—Nicholas Maaskant is reported to be contemplating the installation of an electric-light plant on the ranch he has recently purchased near here, known as the Peter Daggs place.

HAWTHORNE, CAL.—The citizens have voted to establish a lighting district in Hawthorne. Bids will soon be called for by the Board of Supervisors for furnishing and maintaining seventy-five street lamps.

JACKSON, CAL.—James O'Brien, of Amador County, has located 40,000 in. of water in the Consumnes River, to be diverted near the old Hughes bridge between Plymouth and Placerville. The water will be carried down the stream 6 miles, where a power plant will be erected. The water will be used to generate electricity, for irrigation and other purposes.

LOS ANGELES, CAL.—The Pacific Electric Railway Company is planning to build an extension of its railway from Glendale to Burbank, a distance of 4½ miles, contracts for which will be awarded soon.

LOS ANGELES, CAL.—Initial steps have been taken by Mayor Alexander toward the organization of a power and light bureau for the purpose of developing power to generate electrical energy along the line of the aqueduct and constructing plants for generating and distributing electricity for lamps and motors. The Mayor has submitted a communication to the Public Service Commission calling attention to four separate propositions, giving four distinct locations where power may be developed, as follows: San Francisquito No. 2, San Francisquito No. 1, San Fernando and Haiwee. The amount of electrical energy that could be developed at these four places is respectively as follows: 32,000 hp, 60,000 hp, 9000 hp and 10,000 hp. The respective cost would be as follows: $2,300,000, $3,300,000, $750,000 and $1,500,000.

MARYSVILLE, CAL.—The Pacific Gas & Electric Company has announced a reduction in the price of electricity for lamps in the business district of Marysville. To get the benefit of the reduction it will be necessary for the merchants to install a meter and use electricity amounting to more than $7.50 per month. The maximum rate is 8 cents per kw-hour and the minimum 3 cents per kw-hour.

MARYSVILLE, CAL.—The Pacific Gas & Electric Company contemplates abandoning its present ditch and flume system carrying water for 8 miles around the sides of a mountain to the Coalgate plant east of Marysville, and to build a large tunnel through the mountain to carry the water to Coalgate. The company proposes to substitute steel towers for the present poles of the transmission line from Coalgate to San Francisco. Eventually all the main transmission lines will be carried on steel towers.

OROVILLE, CAL.—Plans are being prepared by Clark Standiford for the construction of a tramway up Butte Mountain. The proposed car line will be operated by electricity and will cost about $10,000.

PASADENA, CAL.—The Home Telephone Company is planning to erect a new exchange building in South Pasadena within the next six months, to cost about $50,000. Automatic equipment will be installed.

PATTON, CAL.—Plans have been prepared by N. Ellery, state engineer, for a gas and electric plant to be installed at the State asylum for the insane at Patton. It is said that there is about $12,000 available for equipment for the plant.

PLACERVILLE, CAL.—Notice of appropriation of 15,000 miners' in. of water of the Middle Fork of the Consumnes River has been filed by Henry A. Meyers. It is proposed to build a dam across the Middle Fork of the river and utilize the water to generate electricity and for irrigation purposes near the town of Plymouth.

QUINCY, CAL.—Arrangements are being made by the Plumas Power Company, recently organized, for the construction of a series of hydroelectric power plants to supply electricity for lamps and motors in the Indian Valley. It is said that the transmission line will be extended immediately to Taylorsville and Crescent City.

QUINCY, CAL.—Notice has been filed in the office of the county recorder of appropriation of another large water-power location, claiming 130,000 in. of water in the North Fork of the Feather River, by P. F. Bullington, of Chico, and H. S. Goodman, the water to be diverted by means of a dam located at or near the mouth of Wallace Creek. From there the water will be conducted down the west bank of the North Fork, by means of ditch and tunnel, 2 miles, to a power house to be located at the mouth of Yellow Creek.

SAN BERNARDINO, CAL.—The city of San Bernardino has engaged C. W. Koiner, general manager of the municipal electric-light plant of Pasadena, Cal., to appraise the power plant and distributing system of the Lytle Creek Power Company of San Bernardino. The city is contemplating purchasing the plant to be owned and operated by the municipality.

SOUTH PASADENA, CAL.—Bids will be received by the Board of Trustees until May 8 for installing conduits, wires, post and lamps for lighting certain portions of certain streets in accordance with plans and specifications. William L. Cox is city engineer.

TURLOCK, CAL.—Bonds to the amount of $500,000 have been authorized by the directors of the Turlock Traction Company, the proceeds to be used for the construction of an electric railway between Turlock and Denair, 4 miles in length. S. N. Griffith, of Turlock, is interested in the enterprise.

MIDDLETOWN, CONN.—The Middletown Electric Light Company is contemplating extending its transmission lines to Rockfall and Middlefield to supply electricity for lamps and motors in those places.

WASHINGTON, D. C.—Proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 13 for electric-lighting machinery and accessories at the United States Marine Corps Rifle Range in Washington, D. C.

WASHINGTON, D. C.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 13 for furnishing one 12-kw gasoline engine belted generating set, 200 amp-hour storage battery and accessories, wiring material, etc., at the United States Marine Corps Rifle Range, Winthrop, Md. Plans and specifications can be obtained on application to the above office. R. C. Hollyday is chief of bureau.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until May 9 for furnishing the following supplies at the various naval stations and navy yards: Washington, D. C., Schedule 3510—15,000 ft. oil-proof cable, etc. Brooklyn, N. Y., Schedule 3515—Miscellaneous magnet wire, etc. Bids will also be received until May 16 as follows: Washington, D. C., Schedule 3529—125,000 ft. ingot copper, etc. Applications for proposals should designate the schedule desired by number.

ATLANTA, GA.—The Atlanta Hydro-Electric Power Company is reported to have completed plans for the construction of a hydroelectric power plant, to cost about $3,000,000. The work will include the construction of a high dam and power plant, capable of developing 30,000 hp, and the erection of a transmission line to Atlanta, Ga. The office of the company is located at 1014 Candler Building, Atlanta, Ga.

BARNESVILLE, GA.—At an election held recently the proposition to issue $15,000 in bonds, the proceeds to be used for extensions and improvements to the municipal electric-light plant, was carried.

BUCHANAN, GA.—Preparations are being made for the installation

of a municipal electric light plant. A committee consisting of G. N. Moore and H. S. McCalman has charge of the work.

VIDALIA, GA.—It is reported that the city is contemplating making improvements to the municipal electric-light plant. It is understood that a new generator and other machinery will be installed.

TWIN FALLS, IDAHO.—Plans have been completed for the construction of an electric interurban railway to extend from Twin Falls to the Great Shoshone and Twin Falls on the Snake River. W. L. Cherry and associates are interested in the project.

BLOOMINGTON, ILL.—The circuit court has handed down a decision that the Union Gas & Electric Company has no legal right to operate its system in Bloomington, the company not having received a franchise from the City Council to erect its lines in the streets of the city.

CERRO GORDO, ILL.—The local electric light plant, owned by U. M. Rader & Company, has been purchased by George B. Conover, of Buffalo, N. Y. It is understood that Mr. Conover will continue operating the plant for the present, but later will make arrangements to secure electricity from the transmission lines of the Illinois Traction system.

CHICAGO, ILL.—Judge Kohlsaat, in the United States Circuit Court, has authorized the receivers of the Independent Telephone & Telegraph Company to enter into a traffic agreement with the Illinois Tunnel Company, giving the independent company an entrance into Chicago. Under the proposed agreement connection will be made with independent exchanges in Illinois, Indiana, Kentucky, Ohio, Michigan, Missouri, Tennessee, Iowa, Wisconsin and Minnesota. The agreement runs until 1929 and provides for the division of tolls, 40 per cent to the Illinois Tunnel Company and 60 per cent to connecting lines. F. A. Dolph is receiver of the telephone company.

GEORGETOWN, ILL.—The Georgetown Electric Light Company is reported to be contemplating the construction of a new power house at the Sharon Coal Company's mine, south of this city. Three generators will be installed. The plant will furnish electricity for lamps and motors in Indianapolis, Sidell, Ridgefarm and other towns.

JACKSONVILLE, ILL.—The construction of a new interurban railway, to be known as the Pana, Girard & Jacksonville Railway, is reported to be under consideration. W. O. Myers and Charles Russell, both of Chicago, Ill., are said to be interested in the enterprise.

MANTENO, ILL.—The Village Board has granted the Kankakee Electric Light & Power Company, of Kankakee, Ill., a franchise to furnish electricity for lamps and motors in Manteno for a period of thirty-five years. The Board has also entered into a five-year contract with the company for lighting the streets of the village.

MATTOON, ILL.—The Coles County Telephone & Telegraph Company is reported to have purchased the telephone systems at Oakland and Isabel, giving it complete control of all telephone lines in the county. The consideration is said to be $13,000.

PEKIN, ILL.—The plant and holdings of the Pekin Light, Heat & Power Company and the Citizens Gas & Electric Company have been sold to Hodenpyle, Walbridge & Company, of New York, N. Y.

PEORIA, ILL.—Preparations are being made by the Trustees of the Bradley Institute for the construction of a new power plant for the institute to cost about $65,000. New heating and lighting systems will be installed. M. W. Whitmeyer is the architect and C. O. Poppin is mechanical engineer.

ROCKFORD, ILL.—The Rockford & Interurban Railway Company has increased its capital stock from $1,050,000 to $4,000,000.

ROCKFORD, ILL.—The contract for the installation of lamp standards and lamps for the ornamental lighting system on North Main Street from State to Mulberry Street has been awarded to the Warner Electrical Company.

INDIANAPOLIS, IND.—Bids will be received by the Cincinnati, Madison & Western Traction Company until May 30 for the construction of an electric railway to connect Hanover, Madison, Scottsburg and Lexington, a distance of 41 miles.

RICHMOND, IND.—Preliminary surveys have been completed by the South Bend, Richmond & Southwestern Traction Company for the construction of its proposed electric railway to connect Richmond, Union City, Brownsville and Harrison, a distance of 110 miles. F. C. Charles and Charles W. Jordan are interested in the company.

VINCENNES, IND.—The Vincennes North & South Traction Company, recently incorporated with a capital stock of $100,000, proposes to construct and operate interurban railways. The directors are: E. D. Logsdon, B. M. Willoughby and J. M. House.

HUMBOLDT, IA.—The Humboldt Electric Light & Power Company and the Northern Roller Milling Company are reported to be contemplating the construction of a dam on the Des Moines River and a 1200-hp power plant, to cost about $80,000. Max Toltz, of St. Paul, Minn., is engineer.

HUMBOLDT, IA.—Plans are being considered by the Northern Iowa Power Company for improvements to its water power holdings on the west fork of the Des Moines River, which will increase the power secured from 1000 to 1200 hp. The work contemplated includes the construction of two solid concrete dams, widening mill race, the erection of a large steel and cement fireproof power house. Three large waterwheels and three generators will be installed. Space will be provided for the installation of an additional unit when necessary.

KEOKUK, IA.—The Keokuk Electric Railway & Power Company is in the market for one 800-hp cross-compound Corliss engine with condenser for 140 lb. steam, one 300-kw, single-phase, 133-cycle, 1100-volt, 3-bearing, composite-wound, Westinghouse generator, with exciter and switchboard panel, and one 400-kw, 550-volt generator for railway service with switchboard panel, for its power house in Keokuk. A. D. Ayres, of Keokuk, is general manager.

LANSING, IA.—The City Council has granted the Upper Iowa Power Company, of Decorah, Ia., a franchise to install and operate an electric-light plant in Lansing.

MOUNT VERNON, IA.—Application has been made to the Council for a franchise by the Dows-Smith Company, of Cedar Rapids, Ia., and F. J. Cross, of Monticello, Ia., for the installation of an electric-light plant in Mount Vernon.

ROLAND, IA.—At an election held recently the proposition to issue $10,000 in bonds, the proceeds to be used for the installation of a municipal electric-light and pumping plant, was carried.

WEBSTER, IA.—The City Council has voted to call a special election to vote on the proposition to issue $25,000 in bonds, the proceeds to be used to purchase equipment for the municipal electric plant.

HILL CITY, KAN.—The proposition to install a municipal electric-light plant and water-works system in Hill City will be submitted to a vote of the people.

QUENEMO, KAN.—The Council has engaged I. C. Bushong, of Ottawa, Kan., to prepare plans and specifications for the proposed electric-light plant for this city, to cost approximately $6,000.

LANCASTER, KY.—The local electric-light plant is reported to have been destroyed by fire, causing a loss of about $10,000. It is understood that the plant will be rebuilt at once.

LOUISVILLE, KY.—The Louisville Railway Company has applied to the General Council for a twenty-year franchise to build a crosstown line in Louisville to connect the Twenty-eighth Street line at the West End and the Barrett Avenue line at the East End.

WILLIAMSBURG, KY.—It is reported that the Proctor Coal Company is planning to construct a tunnel through Proctor Mountain and develop a coal tract on Wolf Creek. The company will install an electrical haulway and electrical mining machinery, and will also double the output of its electric power plant to meet the increasing demands made upon it.

NEW IBERIA, LA.—The Teche Land Company is reported to have purchased a site of 100 acres on which it proposes to erect an electric-light plant, sewerage plant and water-works system.

OPELOUSAS, LA.—Preparations are being made to enlarge the municipal electric-light plant and water-works system, which will double the output of the station. Work has commenced on construction of the addition to the power house.

BANGOR, MAINE.—It is reported that arrangements are being made by the Bangor & Aroostook Valley Railway Company for the construction of the so-called Allagash extension this year. The proposed railway will cost about $7,750,000, and calls for about 157 miles of track. A. R. Gould, of Presque Isle, Maine, is interested in the project.

FARMINGDALE, MAINE.—Contracts have been awarded by the Central Maine Power Company for the construction of its proposed new power plant to be located at Farmingdale on the Kennebec River. The company already has several plants, the most important of which is located near Waterville on the Sebasticook River.

BALTIMORE, MD.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until May 15 for furnishing an electric freight elevator in the United States appraisers' stores, Baltimore, Md., in accordance with drawings and specifications, copies of which may be obtained at the above office. James Knox Taylor is supervising architect.

BALTIMORE, MD.—Bids will be received by the Board of Awards at the office of J. Sewell Thomas, City Register, City Hall, Baltimore, Md., until May 10 for supplying ornamental lamp-posts, specifications for which may be obtained at the office of Robert J. McCuen, superintendent of lamps and lighting. J. Barry Mahool is president Board of Awards.

BALTIMORE, MD.—Several manufacturers have taken advantage of the offer of the Department of Lamps and Lighting of Baltimore to exhibit arc lamps for street lighting in Baltimore. The lamps are to be erected by the manufacturers free of cost to the city. The city is contemplating changing the style of lamp in use in the business section of the city. The Board of Awards has rejected the bids for lamp standards for the city hall plaza, on the ground that there were irregularities in the specifications in the bid submitted by the lowest bidder.

BALTIMORE, MD.—The Highways Commission has granted the Towson & Cockeysville Electric Railway Company a franchise to build an electric railway from Townson to Cockeysville.

BALTIMORE, MD.—The Susquehanna Transmission Company, a subsidiary of the Pennsylvania Water & Power Company, of McCall's Ferry, Pa., has applied to the Public Service Commission for permission to issue $1,131,000, the proceeds to be used to pay for the erection of the transmission line from the McCall's Ferry power plant of the Pennsylvania Water & Power Company. The line is nearly completed, and it is estimated that it will require only about $200,000 to complete the work.

HAGERSTOWN, MD.—The Hagerstown & Clearspring Railway Company is reported to have completed surveys for the construction of its proposed electric railway along the old National Pike from Hagerstown to Clearspring, Md. It is understood that the company has secured funds to build the railway and that contracts are to be awarded for construction of the proposed road in the near future. L. N. Downs, of Hagerstown, is president of the company.

PITTSFIELD, MASS.—It is understood that work will soon begin by the Berkshire Street Railway Company on its proposed railway between East Lee and Huntington. Work has already been started in Otis.

SPRINGFIELD, MASS.—The State Railroad Commissioners have granted the Springfield Street Railway Company permission to build an extension across the Ludlow Bridge over the Chicopee River into Ludlow, and also to build an extension in Palmer.

WILMINGTON, MASS.—The citizens have voted to accept the report of the committee recommending the installation of a street-lighting system in the town. An appropriation of $1,500 has been made to light 15 miles of highway with 200 incandescent lamps for the remainder of the year. The service will be supplied by the municipal electric-light plant of Reading, Mass.

WORCESTER, MASS.—The Worcester Consolidated Street Railway Company has applied to the City Council for a franchise to construct extensions and to double-track three of its lines in Worcester.

BENTON HARBOR, MICH.—The City Council has granted the Benton Harbor-St. Joe Railway & Light Company a thirty-year franchise to extend its tracks in Benton Harbor and also for an extension to Dowagiac.

MARQUETTE, MICH.—Bids will be received by the Light and Power Commission until May 20 for the construction of two concrete dams on Dead River, near Marquette. Bonds to the amount of $100,000 have been voted for the construction of the dams and other improvements to the hydroelectric plant on the Dead River. Charles Retallic is superintendent.

AURORA, MINN.—The contract for the installation of an engine and generator, electric conduit, wiring, plumbing and heating system for the new high school in Aurora has been awarded to the Tritchle Electric Company, of Virginia, Minn., for $4,590.

MINNEAPOLIS, MINN.—Plans are being considered by the Electric Short Line Railroad Company for the construction of an extension from Minneapolis to Clara City, 120 miles in length. Frank E. Reed, of Glencoe, is secretary.

MORRIS, MINN.—Plans are being considered by S. Stewart, owner of the local electric-light plant, for improvements to the system, including the installation of a 200-hp engine, dynamo and other improvements.

ST. CLOUD, MINN.—It is reported that the Granite City Railway Company is planning to build a 7-mile extension to its Wade Park car line in St. Cloud, for which a franchise has already been secured.

ST. PAUL PARK, MINN.—The South St. Paul Electric Light, Heat & Power Company has been granted a twenty-five-year franchise to supply electricity for lamps and motors in St. Paul Park. The company will extend its transmission line into St. Paul Park in the near future, probably by the way of Inver Grove and the Inver Grove bridge across the Mississippi River.

ST. VINCENT, MINN.—The installation of an electric-light system in St. Vincent, to cost $4,000, is reported to be under consideration.

WABASHA, MINN.—Plans are being considered to organize a company to be known as the Minnesota-Wisconsin Power Company to supply electricity for lamps and motors in the cities of Wabasha, Lake City, Red Wing, Hastings and Winona. It is said electric energy will be supplied from the local electric plant, which will be enlarged to meet the increased demand.

TUPELO, MISS.—At an election held April 22 the citizens voted to issue bonds to the amount of $50,000, the proceeds to be used for improvements to the municipal electric-light plant, construction of city hall and street paving.

KANSAS CITY, MO.—The City Council has granted the Metropolitan Street Railway Company a franchise to extend its tracks over certain streets in Kansas City.

KANSAS CITY, MO.—The Kansas City Electric Light Company has awarded a contract to the Electric Storage Battery Company, of Philadelphia, Pa., for installation of a storage battery plant at the substation to be erected at Sixth and Walls Streets, at a cost of approximately $100,000.

ST. LOUIS, MO.—The Southern Traction Company of Illinois, of East St. Louis, Ill., has been granted a franchise by the City Council to operate its railway in St. Louis over the Free Municipal Bridge and on the streets in the downtown section of St. Louis.

CARSON, NEV.—The Secretary of the Interior has awarded contracts for electrical apparatus, consisting of alternators and switchboards, for the Truckee-Carson irrigation project to the General Electric Company, of Schenectady, N. Y., for $8,213, and for furnishing hydraulic turbines to the Pelton Water Wheel Company, of San Francisco, Cal., for $9,740.

RENO, NEV.—Rights of way are being secured by the Truckee River General Electric Company for a high-tension transmission line from its new plant near Verdi to Virginia City. Condemnation proceedings have been commenced in the district court to secure the same.

MANCHESTER, N. H.—The Southern New Hampshire Development & Power Company, recently granted a charter, is planning to erect a dam across the Lamprey River at West Epping and storage dams on the Lamprey River in the towns of Raymond, Deerfield and Candia. The company is capitalized at $100,000, and proposes to supply electricity for lamps and motors in Hillsboro and Rockingham counties. The incorporators are: Jeremiah Campbell, of Boston, Mass.; Herbert C. Daggett, of Winthrop, Mass.; George H. Guptill and Charles F. Gardiner, of Raymond, N. H.; William S. Goodrich, of Epping; Arthur W. Dudley, of Brentwood, and Clarence M. Platt, of Manchester.

BURLINGTON, N. J.—The Public Service Utility Commission has approved of the lease of the property and franchises of the Burlington Electric Light & Power Company to the Public Service Electric Company.

MADISON, N. J.—The New England Engineering Company has submitted a report to the Council in connection with improvements and extensions to the municipal electric-light plant, in which the cost is estimated at $18,000.

NEWARK, N. J.—The Elizabeth, New Brunswick & Trenton Railroad Company, recently incorporated, is planning to build an electric railway to extend from Newark to Trenton. The company is capitalized at $500,000. It is understood that the proposed railway will eventually be taken over by the Public Service Corporation.

PRINCETON, N. J.—The State Board of Public Utility Commissioners has approved of the lease of the Princeton Light, Heat & Power Company to the Public Service Electric Company and the Public Service Gas Company. The Public Service Electric Company will take over the electric plant and distributing system and franchises, and the Public Service Gas Company the gas property and franchises.

BROOKLYN, N. Y.—The Public Service Commission has granted the Nassau Electric Railroad Company permission to build its proposed extension between Liberty and Georgia Avenues, extending along Georgia Avenue to Atlantic Avenue and connecting with the existing track of the Brooklyn, Queens County & Suburban Railroad Company in Georgia Avenue.

CENTRAL ISLIP, N. Y.—Sealed bids will be received until May 10 by the State Commission on Lunacy for additional equipment for power plant, including one direct-connected engine and alternating-current generator and changes in switchboard for the Central Islip State Hospital, Cetral Islip, N. Y. Bids will also be received at the same time and place for fire escapes for hospital.

JAMESTOWN, N. Y.—The Electric Light Commission has authorized the Mayor to contract with the General Electric Company for 150 magnetite arc lamps and appurtenances. The equipment will call for two complete outfits, calling for seventy-five lamps each, to cost $6,959. The lamps will take 6.6 amp and be operated on 2300-volt, 60 cycle, alternating current circuits.

MIDDLEPORT, N. Y.—The Public Service Commission, Second District, has authorized the Middleport Gas & Electric Company to begin work on the erection of its transmission lines in Hartland to furnish electricity for lamps and motors in that town.

NEW YORK, N. Y.—The Council has granted the Union Railway Company a franchise to build an extension on St. Ann's Avenue from 161st Street to the Southern Boulevard, in New York.

NEW YORK, N. Y.—Plans have been filed with the Superintendent of Buildings, Rudolph P. Miller, by the New York Telephone Company for the construction of a seventeen-story building, at a cost of $1,400,000, to be located at Walker and Lispenard Streets. Cyrus L. W. Eidlitz is architect.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Park Avenue and Fifty-ninth Street, New York, N. Y., until May 8 for installing electric equipment in new Public School 165, on Hopkinson and Lott Avenues and Amboy Street, Brooklyn, and for installing electric equipment in new Public School 95, on West Houston and Clarkson Streets, New York.

RICHMOND, N. Y.—Bids will be received at the office of the President of the Borough of Richmond, Borough Hall, St. George, New Brighton, N. Y., until May 9 for furnishing material required and installing railing and pedestal lamp posts on Jay Street and South Street retaining walls, railing and tablets on Stuyvesant Place retaining wall, and curb lamp posts on Jay Street, South Street, Hyatt Street, Stuyvesant Place, Central Avenue, Arrietta Street and Griffin Street, in connection with part of the street improvements authorized for the St. George ferry approach, contract No. 6. The material required is estimated as follows: 3800 lin. ft. of railing; thirty lamp posts furnished and placed on pedestals, forty lamp posts furnished and placed on curb line and one double-lamp lamp post placed on concrete base, complete. Plans and specifications and form of contract may be obtained at the office of the engineer of the borough, Borough Hall, St. George, Staten Island, N. Y. George Cromwell is president.

SYRACUSE, N. Y.—Preparations are being made by the Syracuse Lighting Company to extend the zone of the ornamental lighting system, both north and south of the canal, work on which will begin in the near future.

SYRACUSE, N. Y.—The Bell Telephone Company has secured control of the Onondaga Independent Telephone Company, of Syracuse, and of the Home Telephone Company, of Utica, with subsidiary companies controlled by both companies. The deal is said to have involved a cash payment of $1,250,000.

WATERTOWN, N. Y.—The City Council has granted the Black

River Traction Company a franchise for the Washington Street extension.

OXFORD, N. C.—The Oxford Electric Light Company, recently incorporated with a capital stock of $15,000, is reported to be contemplating supplying both gas and electrical service in Oxford. A. H. Powell, of Oxford, N. C.; C. M. Calvert, of College Park, Md., and Charles F. Nesbitt, of Washington, D. C., are interested in the company.

BARBERTON, OHIO.—The City Council is reported to have granted the Barberton Light & Power Company a franchise to erect transmission lines on the streets of the city for a term of eight years.

CLEVELAND, OHIO.—The Cleveland Light & Power Company has increased its capital stock from $150,000 to $250,000.

CLEVELAND, OHIO.—The Lincoln Electric Company has filed a certificate with the Secretary of State showing an increase in its capital stock from $10,000 to $200,000.

DAYTON, OHIO.—Plans are being prepared by the Dayton & Troy Electric Railway Company and the Oakwood Street Railway Company, of Dayton, Ohio, for the construction of a joint power house, to be located at Tipp City, to cost about $150,000.

COALGATE, OKLA.—The plant and holdings of the Oklahoma Electric & Refrigerating Company have been acquired by S. W. Lane, of Coalgate. The officers of the new company are: S. W. Lane, president; M. D. Paydrick, vice-president; J. W. Jacobs, secretary, and H. W. Reager, superintendent.

MUSKOGEE, OKLA.—It is reported that arrangements have been completed by the Grand River Power Company for the construction of a dam on the Grand River at Muskogee, work on which will begin at once. C. N. Haskcel, of Muskogee, is interested in the enterprise.

SNYDER, OKLA.—It is reported that contracts have been awarded by the Board of Trustees for the construction of a new electric-light plant, to cost about $25,000.

KLAMATH, ORE.—The Klamath Power Company has taken over the plants and holdings of the Klamath Falls Light & Water Company. The deal involves about $500,000 and includes the purchase of two electric light and power plants in Klamath Falls and all of the water pipes and electric transmission lines throughout the city, and also from Klamath to Merrill, 22 miles to the south, and to Bonanza, 25 miles east. The company is said to be a subsidiary of the Siskiyou Electric Light & Power Company, of Yreka, Cal. The Siskiyou company was recently denied a franchise to transmit electricity from its large power plant on the Klamath River, 20 miles distant, to this city.

OREGON CITY, ORE.—The officials of the Canby Canal Company are reported to be contemplating the construction of an electric railway from Canby to Molalla, with feeders extending to Beaver Creek, Meadow Brook, Colton, Needy and Macksburg.

EASTON, PA.—The General Chemical Company is reported to have awarded the contract for construction of a power house to Gilpin-Guernsey Company for $50,000.

PHILADELPHIA, PA.—It is reported that only one bid was received for the work in connection with the installation of an ornamental lighting system on South Broad Street boulevard, which was submitted by Edwin H. Vare, for $69,900. The work is to be done under the supervision of the electrical bureau and includes the installation of four lines of electric conduits for cables to feed 420 tungsten lamps and 190 arc lamps.

POTTSTOWN, PA.—The Pottstown & Phœnixville Railway Company has applied for a charter in Pennsylvania to build an electric railway from Spring City to Saratoga, via Royersford. The incorporators are: George N. Malsberger, Harry F. Swinehart, of Pottstown, and C. Taylor Leland, of Philadelphia, Pa.

SOMERSET, PA.—Preparations are being made to begin work on the construction of an electric railway between Somerset and Rockwood. G. C. Winslow is chief engineer.

UNION CITY, PA.—The Keystone Electric Light Company is reported to have been granted a franchise to install an electric-light plant and transmission lines in Union City. L. D. Shreve is interested in the project.

WASHINGTON, PA.—It is reported that contracts will soon be awarded for the construction of the first section of the new Fairmont & Pittsburgh traction system. The work will begin at Blacksville and extend north to Waynesburg, a distance of 13 miles.

WELLSBORO, PA.—Surveys are being made by the Tioga Traction Company for its proposed electric railway between Wellsboro and Mansfield. The company is also contemplating building a branch to Blossburg. J. F. Fisher is chief engineer.

WYOMISSING, PA.—The citizens have adopted the recommendation of the special committee appointed to establish a municipal electric-light and power plant. The committee has been authorized to proceed at once to make preparations for construction of the plant. Bonds to the amount of $60,000 will be issued for the proposed system.

ABBEVILLE, S. C.—The construction of an electric railway from Abbeville to Antreville, a distance of 12 miles, is under consideration. Surveys have already been made for the proposed railway under the direction of W. H. H. Newell, civil engineer, of Anderson, S. C.

CAMDEN, S. C.—The construction of an electric railway to extend from Camden to Sumter, a distance of 30 miles, is reported to be under consideration. R. E. Sharpe, of Rembert, S. C., is interested in the project.

CHATTANOOGA, TENN.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until May 26 for furnishing an electric passenger elevator for the United States court house and post office at Chattanooga, Tenn., plans and specifications for which may be obtained at the above office. James Knox Taylor is supervising architect.

GALLATIN, TENN.—The Nashville-Gallatin Interurban Railway Company has applied for a charter to construct and operate an electric railway between Nashville and Gallatin, a distance of 30 miles. The capital stock is placed at $750,000. H. H. Mayberry, John A. Pitts and R. W. McLemore are the incorporators.

RIDGEDALE, TENN.—The Eastern Tennessee Power Company, of Parksville, Tenn., it is said, is planning to erect a substation at Ridgedale, where electricity transmitted from its plant on the Ocoee River will be transformed for distribution for lamps and motors. The cost of the building and equipment is estimated at about $75,000. J. G. White & Company, 43 Exchange Place, New York, N. Y., are engineers.

DENTON, TEX.—Arrangements have been completed whereby the Denton Traction Company will extend its street-car system into the north part of the city and to the College of Industrial Arts. A bonus of $3,000 was raised by the citizens to secure the extension. R. J. Wilson is manager.

EAGLE DAM, TEX.—Bids will be received at the office of the United States Reclamation Service, 605 Federal Building, Los Angeles, Cal., until May 15 for furnishing equipment for steam power plant for the Rio Grande River project of New Mexico and Texas. The equipment to include three 625-kva steam turbo-generating units, two steam turbine-driven exciters, controlling switchboards, including three feeder panels, three condensers with circulating air pumps, four water-tube boilers two boiler-feed pumps, one feed-water heater, steam and feed-water piping and other apparatus. The plant will supply electricity to operate derricks, cableways, hoists and heavy excavating machinery for construction work.

FT. STOCKTON, TEX.—The City Council has granted W. F. Zarbach and Charles A. Shroff, of Cleveland, Ohio, a ten-year franchise to construct and operate an electric-light and ice plant in Ft. Stockton. The cost of the proposed plant is estimated at about $20,000.

HEARNE, TEX.—It is reported that the city has voted to issue bonds for the construction of an electric-light plant.

HOUSTON, TEX.—It is reported that the W. E. Ule Construction Company has secured the contract for the construction of an electric interurban railway to extend from Houston to La Porte and Sylvan Beach. A. Foster Irwin is said to be interested in the project.

LONGVIEW, TEX.—Bonds to the amount of $90,000 are reported to have been voted, the proceeds to be used for electric-light system, paving, etc. C. A. Bodenham is Mayor.

MISSION, TEX.—It is reported that the Mission Land & Improvement Company is contemplating the installation of an electric light and power plant and water-works system in Mission. Steps have also been taken by the company to install an ice and pre-cooling plant.

PORTLAND, TEX.—The installation of an electric-light plant and water-works system in Portland is reported to be under consideration.

PORT LAVACA, TEX.—Application has been made to the City Commissioners by W. E. Snell for a franchise to install an electric light plant and water-works system in Port Lavaca.

TROUP, TEX.—The local electric light plant is reported to have been purchased by R. C. Schumate, of Zephyr, Tex. It is understood that the new owner will make improvements to the plant.

LOGAN, UTAH.—Mosiah Evans and associates are making arrangements to erect a transmission line from the power plant in the Bear River Canyon to supply electricity for lamps and motors in Logan.

BRISTOL, VA.—The Bristol Traction Company, recently organized, has purchased the properties of the Bristol Belt Line Railway Company in Bristol, including all the electric railways in operation. It is understood that improvements and extensions, involving an expenditure of about $100,000, will be made by the new company. The Holston Valley Railway, owned by the new company, will be equipped for electrical operation between Bristol and Big Creek Park, a distance of 10 miles. Fred Dulaney, of Bristol, Va., is manager.

HAMPTON, VA.—The Newport News & Old Point Railway & Electric Company is reported to be contemplating making improvements to its power plant, including the installation of one 575-hp boiler. W. J. Payne, of Richmond, Va., is president.

LYNCHBURG, VA.—Arrangements are being made by the Postal Telegraph Company to place its trunk wires underground on Jefferson Street.

BREMERTON, WASH.—The Puget Sound Southern Railway Company has applied for a franchise to construct and operate an electric railway in Bremerton. It is understood that the company proposes to seek a franchise in Charleston, 4 miles distant, and to build a line between the two cities. Plans have been prepared for extending the system ultimately to Port Orcard, Clifton, Union City, Shelton and into the Grays Harbor district. Electricity for operating the proposed railway will be furnished by a hydroelectric power plant.

HOQUIAM, WASH.—The Council has granted the Gray's Harbor Railway & Light Company, of Aberdeen, permission to extend its system to Hoquiam.

MONTESANO, WASH.—An election will soon be called to submit the proposition to issue bonds to the amount of $125,000, the proceeds to be used to purchase the plant of the Montesano Water & Light Company, to be owned and operated by the city.

NORTH YAKIMA, WASH.—The ranchers of the Selah Valley have decided to ask the Yakima Valley Transportation Company to extend its electric-railway system through the valley. It has been decided to give the company 9 miles of right-of-way, including about 32 acres of land for the building. The proposed railway is to extend through the valley to the entrance of the Wenas.

PORT ORCHARD, WASH.—Bids will be received until May 20 by the Board of Control, at Olympia, Wash., for the construction of a power plant in connection with the new hospital at the Veterans' Home, to be erected in Port Orchard.

SPRINGDALE, WASH.—The Washington Water Power Company is preparing to build a steam railroad from Springdale to the site of its new power plant on the Spokane River, 22 miles in length, to transport material for the construction of its plant.

WENATCHEE, WASH.—Plans are being considered for the construction of an electric railway in Wenatchee and through the Wenatchee Valley. Application will soon be made to the City Council in Wenatchee and to the Chelan County Commissioners for franchises for the proposed railway. Louis W. Pratt and Walter M. Harvey are interested in the project.

WHEELING, W. VA.—A movement is on foot among the residents of Mozart Hill and vicinity to organize a company for the purpose of constructing and operating an electric railway from the top of the incline above Forty-third Street, Wheeling, to Sherrard, and also to purchase and operate the old inclined railroad at Mozart Park.

WHEELING, W. VA.—The Consumers' Electric Company and the Wheeling Electrical Company are reported to have been consolidated under the name of the Wheeling Electric Company. The Consumers' Electric Company is constructing a large electric plant, contracts for which, it is understood, have been awarded.

CEDARBURG, WIS.—The Milwaukee Northern Railway Company is reported to be contemplating an extension of its electric railway to West Bend this summer.

LA CROSSE, WIS.—The construction of an electric light plant at Lake Como is said to be under consideration. Julius Burkhart, Leonard Fey and Wenzel J. Hickisch, of La Crosse, Wis., are said to be interested in the project.

LA CROSSE, WIS.—Plans have been completed by the La Crosse Water Power Company for the construction of a third dam and power house to be located on the main channel of Black River, 8 miles above Hatfield. Plans are also being prepared by the company for the construction of a fourth dam and second power house between Hatfield and Black River Falls, to cost approximately $500,000.

STOUGHTON, WIS.—The contract for the construction of an electric-light plant on the Yahara River to supply electricity for lamps and motors in Stoughton has been awarded to the Power Engineering Company, of Minneapolis, Minn. The proposed plant will cost about $75,000 and will develop 250 hp.

SUN PRAIRIE, WIS.—At an election to be held May 9 the proposition to issue $9,000 in bonds, the proceeds to be used for improvements and extensions to the municipal electric-light plant, will be submitted to a vote.

VANCOUVER, B. C., CAN.—The City Council has given the Western Canada Power Company an extension of nine months from April 23 in which to complete its system and furnish power in Vancouver.

VANCOUVER, B. C., CAN.—Plans are being prepared by the British Columbia Telephone Company for extensions and improvements to its system this year, which will involve an expenditure of about $1,000,000. William Farrell is president of the company.

VANCOUVER, B. C., CAN.—The Howe Sound Power Company has filed notice of application of 40 cu. ft. per second of water from Furry Creek, to be utilized for power development purposes.

VANCOUVER, B. C., CAN.—Contracts have been awarded by the British Columbia Electric Railway Company for the installation of an additional generating unit at the Lake Buntzen generating station, consisting of a 10,000-hp Doble water wheel, which will be supplied by the John McDougall Company, of Montreal, Que., Can., and an alternating-current generator, manufactured by the Canadian General Electric Company, of Toronto, Ont., Can. The contract for the penstock to supply the new unit was awarded to McDonald & Godson.

PORTAGE LA PRAIRIE, MAN., CAN.—The power committee of the City Council has engaged W. E. Skinner, of Winnipeg, Man., to make a report of the cost of the erection of a transmission line from Winnipeg to Portage La Prairie, including transformer station and distributing plant, in order to be able to give an answer to the proposition submitted by the City Council of Winnipeg to furnish electric energy from the Winnipeg municipal plant at Point du Bois.

WINNIPEG, MAN., CAN.—Tenders will be received by the Board of Control until May 15 for installing six 500-kw step-down transformers for substation No. 1. Specifications and further information may be obtained from Smith, Kerry & Chace, engineers, Carnegie Library Building, Winnipeg, Man. M. Peterson is secretary of Board of Control.

MIDLAND,, ONT., CAN.—The ratepayers have voted in favor of the by-law authorizing the town of Midland to secure electrical energy from the Hydroelectric Power Commission and to expend $13,000 for the erection of a distributing plant.

TORONTO, ONT., CAN.—Tenders will be received by the Chairman of Board of Control, City Hall, Toronto, Ont., until May 23 for steel crossing towers. Specifications and forms of tenders may be obtained from the Toronto Hydroelectric System, City Hall, Toronto. G. R. Geary, Mayor, is chairman of Board of Control.

WELLAND, ONT.—The Niagara Falls, Welland & Lake Erie Railway Company has awarded the contract for construction of its street railway system in the town of Welland to Hendrick H. Leach & Company. C. J. McLaughlin is president of the railway company.

MONTREAL, QUE., CAN.—E. A. Robert, president of the Canadian Light & Power Company, has submitted plans to the Dominion government in connection with a large hydroelectric development at Cedar Rapids, on the St. Lawrence River, which will involve an expenditure of from $15,000,000 to $20,000,000. The plans include large chutes over the Coteau and Cedar Rapids, about 25 miles above Montreal.

MELVILLE, SASK., CAN.—The ratepayers have voted in favor of the by-law authorizing an expenditure of $23,000 for the construction of an electric-light plant.

PRINCE ALBERT, SASK., CAN.—Tenders will be received by the City Commissioners until May 31 for the following equipment: A.—One 100-hp cross-compound engine, with necessary condensing apparatus, steam piping installed complete. Bids on engines of the following classes will be considered: (1) Horizontal cross-compound, Corliss engine, 125-150 r.p.m. (2) Vertical cross-compound, Corliss engine, 125-150 r.p.m. (3) Vertical cross-compound, quick revolution engine, forced lubrication. B.—One 600-kw, 2200-volt, 60-cycle, three-phase engine type alternator, exciter, switchboards, automatic regulator, installed complete. C.—One 72-in. x 18-ft return tubular boiler, suitable for 150 lb. working pressure. Specifications will be furnished on application to the City Commissioners, or to R. Wright, city electrician.

WEYBURN, SASK., CAN.—The municipal electric light and power plant, operating in connection with the water works and sewerage systems, has been completed and put in operation. The equipment consists of a 250-kw alternating-current generator direct-connected to a cross compound Corliss engine; a 75-kw generator and Corliss engine and a 7-panel switchboard. The pumping equipment includes one 50-hp gasoline engine and one 50-hp motor attached to two 8x12 double-acting pumps, having a capacity of 300 gallons per minute each. The plant now supplies electricity for 30 street lamps and 6000 incandescent lamps.

ANGOSTURA, SONORA, MEX.—Preliminary surveys are being made for the construction of a hydroelectric power plant and irrigation system in the Yaqui and Bavispe valleys. It is proposed to build a dam 180 ft. high on the Bavispe River, near Angostura, which will form a water storage reservoir of large capacity. The Richardson Construction Company, of Los Angeles, Cal., is reported to be interested in the project.

New Industrial Companies.

THE BEAVER ENGINEERING COMPANY, of Newark, N. J., has been incorporated with a capital stock of $100,000 by C. M. Myers, A. L. Myers and M. G. Hammerschlag, of Newark, N. J. The company proposes to manufacture electric motors, dynamos, electrical machinery, etc.

THE BECK AUTOMATIC ELECTRIC SAFETY & SIGNAL SWITCH COMPANY, of St. Louis, Mo., has been chartered with a capital stock of $50,000 by Morris Tucker, Arthur Beck and Charles Beck.

THE CHISHOLM TRANSMITTER & TELEPHONE INSTRUMENTS COMPANY, of New York, N. Y., has been incorporated with a capital stock of $750,000 by T. E. Wing, P. W. Russell, B. D. Wheadon and R. Bennett, of New York, N Y. The company proposes to manufacture and deal in telephone instruments.

THE ELECTRIC GRANITE SAW COMPANY, of New York, N. Y., has been incorporated to acquire and operate quarries, etc. The company is capitalized at $350,000, and the incorporators are: J. J. Smith, J. C. Wait, of the Bronx, and P. Ryan, of Brewsters, N. Y.

THE ELECTRIC HEATER COMPANY, of Cincinnati, Ohio, has been chartered with a capital stock of $50,000 to manufacture electrical devices. The incorporators are: T. F. Bailey, H. F. Bohecker, F. L. Mowry, William H. Miller

THE ELECTRIC SEAL & STAMP COMPANY, of New York, N. Y., has been incorporated by D. A. Sterling, W. C. Lovatt and C. J. Kleber, of New York, N. Y. The company is capitalized at $25,000 and proposes to manufacture electric seals, electric stamping machines, etc.

SAMUEL GARVIN & COMPANY, of Chicago, Ill., have been incorporated with a capital stock of $15,000 by F. William Keagh, Alonzo C. Heckler and Samuel Garvin.

THE IDAHO ELECTRIC MANUFACTURING COMPANY, of Pocatello, Idaho, has been incorporated by John A. Tupper, M. E. Hughes,

Timothy Kinney, Pocatello, Idaho, and others. The company proposes to manufacture electric ranges.

THE INTERNATIONAL ACCESSORIES MANUFACTURING COMPANY, of Portland, Maine, has been chartered with a capital stock of $1,000,000 to manufacture and deal in motors and machinery of all kinds. A. F. Dunham is president and M. S. Wells treasurer, both of Portland, Maine.

THE LOS ANGELES ELECTRIC VEHICLE COMPANY, of Los Angeles, Cal., has been incorporated with a capital stock of $200,000 by S. Hendricks, P. L. Lindley, W. K. Crawford, C. E. Nester and J. A. Lightpipe

THE RICHEY TELEPHONE LOCK & CALL REGISTER COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $100,000. The incorporators are: C. V. Richey, E. H. Booth, of Washington, D. C., and R. T. Ward, of Baltimore, Md.

New Incorporations.

ELBERTON, GA.—The Elberton & Eastern Railway Company has been organized to build an electric railway to connect Elberton, Tignall, Washington and Lincolnton. The company will be capitalized at $500,000, and the incorporators are: M. A. Pharr, of Washington, Ga.; James A. Moss, W. J. Adams and J. J. Wilkinson, of Tignall; W. O. Jones, Z. B. Rogers, and others, of Elberton.

NORTONVILLE, KY.—The Norton Traction Company has been incorporated with a capital stock of $100,000 by Frank E. Mehr, of Columbus, Ohio; Frank G. Hoge, of Nortonville, Ky., and T. F. Callard, of Hopkinsville, Pa. The company proposes to build an electric railway in Nortonville.

AUBURN, MAINE.—The Crystal Co-operative Association has been incorporated with a capital stock of $175,000 for the purpose of dealing in real estate and water-power sites, and also proposes to supply electricity for lamps and motors. H. Vrooman, of Providence, R. I., is president, and J. E. Young, of Brookline, Mass., treasurer.

KITTERY, MAINE.—Articles of incorporation have been filed for the Newmarket Electric Company with a capital stock of $100,000 by Edwin G. Eastman, Exeter, N. H.; Fred B. Philbrick, of Newmarket, N. H., and Horace Mitchell, Kittery, Maine.

PORTLAND, MAINE.—The Victor-American Power Company has been incorporated by Clarence E. Eaton, Albert F. Jones, Albert A. Richards, B. M. Maxwell and Clarence G. Trott, all of Portland, Maine. The company proposes to supply electricity for lamps, motors, heating, etc.

KANSAS CITY, MO.—Articles of incorporation have been filed for the Costelow-Canham Electric Company with a capital stock of $3,000 by John F. Costelow, E. E. Canham, Jr., and E. E. Canham, Sr.

BERNARDSVILLE, N. J.—Articles of incorporation have been filed for the Bernards Electric Company by S. S. Childs, T. B. Smith and C. M. Henry, of Bernardsville, N. J. The company is capitalized at $500,000 and proposes to supply electricity for lamps, heat and motors.

AUBURN, N. Y.—The Empire Gas & Electric Company has been incorporated with a capital stock of $900,000 by J. A. Seymour, F. Sefton and G. W. Bowen, of Auburn, N. Y. The company proposes to supply electricity and gas.

LINWOOD, N. C.—The Fairmont-Silver Telephone Company has been incorporated by G. C. Palmer, of Silver Hill, N. C., and others. The company is capitalized at $20,000, and proposes to erect a telephone line from Southmount and Silver Hill to Lexington. Post office address, Linwood, R. F. D., No. 2.

HANKINSON, N. D.—Articles of incorporation have been filed for the Hankinson-Carleton Electric Company with a capital stock of $25,000 by M. E. Phillips, E. L. Carleton, John H. Cahhan, J. G. Eager and George F. Phillips, all of Jamestown. The company proposes to supply electricity in Hankinson.

VAN BUREN, OHIO.—The Hills & Dales Railway Company has been incorporated with a capital stock of $25,000 by William Stroop, Edwin P. Matthews, of Clayton, Ohio; Albert C. Rice and O. J. Emrick. The company proposes to build a street railway.

ARCHBALD, PA.—The Archbald Light, Heat & Power Company has been incorporated with a capital stock of $5,000. The directors are: Frederick W. Stillwell, Y. M. C. A. Building, Scranton, Pa.; Alvan Markle, of Hazleton, Pa.; C. D. Simpson, of Scranton, Pa., and James Butler, of Moosic, Pa.

ARONA, PA.—The Arona Electric Company has been incorporated with a capital stock of $5,000. The directors are: George T. Smith, Cain and Dursan Avenues, Pittsburgh, Pa., treasurer; F. J. Taylor, of Homestead, Pa., and William H. Larimer, of Wilkinsburg, Pa.

ASPINWALL, PA.—The Redstone Electric Company has been granted a charter with a capital stock of $5,000. The directors are: C. R. Turton, of Aspinwall, Pa.; C. C. McBride, of Ingram, Pa., and W. F. Craig, of Swissvale, Pa.

DUNMORE, PA.—The Dunmore Electric Company has been granted a charter by the Secretary of State. The directors are: C. D. Simpson, Louis W. Healy, of Scranton, Pa., and James Butler, of Moosic, Pa.

Personal.

MR. DAVID G. HOWEY has been appointed superintendent of the Kilbourn Municipal Electric Light Plant, Kilbourn, Wis.

MR. HORACE F. HILL, of Indianapolis, has been elected general manager of the Chicago Telephone Company, succeeding Mr. Angus S. Hibbard, resigned.

DR. OTTO FEUERLEIN, manager of the incandescent lamp factory of Siemens & Halske, Berlin, Germany, arrived in this country on April 24 to remain until June 1.

MR. PAUL P. BIRD, until recently smoke inspector for the city of Chicago, has taken a position with the contract department of the Commonwealth Edison Company, Chicago.

DR. C. P. STEINMETZ will be the chief speaker at a meeting of the Toronto Section of the A. I. E. E. to be held on May 5. His subject will be "The Nature of Transients in Electrical Circuits."

MR. D. McF. MOORE will deliver a lecture on vacuum tube lighting before the Commercial Association of the Public Service Corporation of New Jersey in Newark on April 4.

MR. W. T. SHARP, who was formerly connected with the Citizens Railway, Light & Power Company, of Newport News, Va., has been appointed superintendent of the Emporia (Va.) Hydroelectric Power Company.

MR. THEODORE N. VAIL, president of the American Telephone & Telegraph Company, has been elected a director of the New York, New Haven & Hartford Railroad Company, succeeding the late Nathaniel Thayer, of Boston.

PROF. C. L. DE MURALT, of the electrical engineering department of the University of Michigan, will address the Toledo section of the A. I. E. E. on May 5, his subject being "Modern Developments in Trunk Line Electrification."

PROF. C. L. CORY, of the electrical engineering department of the University of California, has been appointed consulting and investigating engineer by the Berkeley City Council to determine the proper rate for electricity at that place.

DR. K. G. FRANK, the representative in this country of the Siemens & Halske and Siemens-Schukert companies of Berlin, Germany, sailed for Europe on the steamer *Cleveland* on April 27. Dr. Frank will remain in Europe until Sept. 1.

PROF. ALEXANDER GRAHAM BELL will be honored as the inventor of the telephone by his birthplace, Brantford, Ontario, Canada, where a memorial will be erected, to be in readiness for the formal eclebration on Dominion Day, July 1, 1912.

MR. H. A. SINCLAIR, who served as treasurer of the New York Electrical Society for twenty-five years, has been presented with a testimonial in recognition of his faithful service throughout this period, during which the membership increased from about 100 to almost 1000.

MR. WILLIAM J. WILGUS, formerly chief engineer in charge of electric traction of the New York Central & Hudson River Railroad, has been awarded the Telford gold medal for the paper read by him at a recent session of the Institution of Civil Engineers of Great Britain.

MR. BION J. ARNOLD has been appointed chief engineer of the Chicago Association of Commerce committee on model downtown streets. Mr. Arnold is also chief subway engineer for the city of Chicago, so that this new appointment will in a measure supplement the older one.

MR. A. A. GRAY, general manager of the *Electrical Review and Western Electrician,* has been appointed vice-president of the Electric Club of Chicago, succeeding Mr. C. A. Howe, who resigned, owing to his removal from the city. Mr. Gray will succeed Mr. Howe also as chairman of the speakers committee of the club.

MR. W. H. WELLS, district manager of the Edison Electric Illuminating Company of Brooklyn, in accordance with the company's usual method of filling vacancies from its ranks, has been transferred to a similar position at the main office to fill the vacancy caused by the resignation of Mr. Parker H. Kemble.

MR. H. C. STERLING, for a number of years superintendent of the municipal electric light and water-works plant at New London, Wis., is now manager of the Constantine Hydraulic Company, with headquarters at Three Rivers, Mich. This company has a hydroelectric plant at Constantine, Mich., and supplies electrical energy to several towns. Mr. Sterling has been a familiar figure at conventions of the old Northwestern Electrical Association and of the present Wisconsin Electrical Association.

MR. J. C. WOODSOME, formerly superintendent of the Dallas (Tex.) Electric Light & Power Company, has been appointed general manager of the Tampa Electric Company at Tampa, Fla., succeeding Mr. J. A. Trawick, who has removed to Keokuk, Ia., to take charge as manager of the hydroelectric development now under construction utilizing the Mississippi River at that point. Mr. Woodsome is succeeded at Dallas by Mr. Herbert Nash, Jr., who comes from the Stone & Webster plant at Houghton, Mich., where Mr. Woodsome was also formerly stationed.

MR. GEORGE A. DAMON, managing engineer for the Arnold Company, Chicago, Ill., has been appointed dean of the School of Engineering of Throop Polytechnic Institute, Pasadena, Cal. Mr. Damon was born in Chesaning, Mich., on April 7, 1871. He was educated in the

grammar school at Detroit and the high school at Ypsilanti, and was graduated from the latter in the class of 1889. Meanwhile, Mr. Damon had gained experience as a freight clerk with the Michigan Central Railroad at Ypsilanti. Subsequently he entered the University of Michigan, but his work at the university was interrupted in 1893, when he took charge of the educational exhibit of the university at the World's Fair in Chicago. Shortly thereafter Mr. Damon became connected with the Fisher Electric Company, which he served in the drafting room and shop. In the fall of 1894 he returned to the University of Michigan and completed his course. In September, 1895, Mr. Damon became connected with Bion J. Arnold, who had recently opened an office in Chicago as a consulting engineer, and he has been connected with Mr. Arnold continuously since that time. At first, Mr. Damon's work with Mr. Arnold was along consulting engineering lines, but when the Arnold Electric Power Station Company was organized Mr. Damon became prominently affiliated with the work which it carried out in different parts of the country. In 1908 and 1909 Mr. Damon served as first assistant to Mr. Arnold in the work which he carried out as consulting engineer to the Public Service Commission of the First District of New York. In 1910 Mr. Damon directed the investigation by Mr. Arnold of transportation facilities in the Pittsburgh district for the Mayor in connection with the plans for a greater Pittsburgh. Since January, 1911, he has been in Los Angeles, Cal., in charge of the appraisal of the property of the Southern California Edison Company, and has recently taken up the preliminary studies for Mr. Arnold of the transit problems of Los Angeles. His work at Throop Institute will not interfere with his duties in connection with the Arnold Company.

MR. PARKER H. KEMBLE, district manager of the Edison Electric Illuminating Company, of Brooklyn, N. Y., has been appointed general sales manager of the Toronto Electric Light Company, Toronto, Ont.

PARKER H. KEMBLE.

Mr. Kemble was educated in the arts and sciences at Harvard, the Technology School in Dresden, Germany, and the Massachusetts Institute of Technology. His theoretical training was supplemented by practical experience in marine and mechanical engineering in the shipyards of William Cramp & Sons, Philadelphia. Later he joined the engineering staff of the Boston Elevated Railroad Company, where he was employed in the design of power stations and cars. When the Windsor Locks Electric Lighting Company, the Enfield Electric Light & Power Company and the Enfield Gas Company were consolidated into the Northern Connecticut Light & Power Company of Windsor Locks, Conn., Mr. Kemble was engaged to rebuild and operate the combined system. An account of this interesting work appeared in our issue of May 5, 1910. Prior to joining the staff of the Brooklyn Edison Company Mr. Kemble was employed by the National Electric Light Association as acting executive secretary in the preparation and handling of the Atlantic City convention. His wide experience and training made him a valuable asset of the Edison company and fit him admirably for his new post. Mr. Kemble is a member of the American Society of Mechanical Engineers and the Society of Naval Architects and Marine Engineers. He is also an associate member of the American Institute of Electrical Engineers, United States Naval Institute and American Society of Naval Engineers.

MR. NORMAN MACBETH, for twelve years consulting engineer in the gas and electric lighting fields, and for the past two years engineer in charge of the illuminating engineering laboratories of the Welsbach Company, on May 1 assumed the position of illuminating engineer of the Westinghouse Electric & Manufacturing Company and the Westinghouse Lamp Company. Mr. Macbeth was born in Stayner, Ontario, Canada, in 1873. From 1890 to 1897 he was engaged in the practical work of installing gas and electric equipment, in the latter year giving part of his time to the manufacture of aluminum reflectors of his own design for show-window lighting with gas lamps. From 1897 to February, 1909, he acted as consulting engineer, devoting his attention to gas and electric lighting problems and giving special attention in the former part of this period to the inspection of meters and the adjustment of rate and bill complaints. Through his knowledge of the subject, his practical turn of mind and his adherence to sound business ethics, Mr. Macbeth succeeded in establishing for himself an enviable reputation. A portion of his time during the latter part of this period was devoted to constructing as well as consulting illuminating engineering. In 1908 he engineered, in Philadelphia, the first complete installation of inverted gas lamps to be designed in accordance with illuminating engineering principles. His work with the Welsbach Company began in February, 1909. During the two years in this service he has created a well-equipped department of illuminating engineering as applied to gas lighting. Mr. Macbeth has been a frequent contributor to the technical press and to the proceedings of the Illuminating Engineering Society. He was the first to work out the "flux-polar diagram" for determining the mean spherical candle-power from the polar distribution curve. He is the inventor of the "Macbeth Illuminating Engineering Calculator," considered as useful in making calculations in illumination as the regular slide rule is in other engineering problems. Mr. Macbeth is a member of both the American and British Illuminating Engineering Societies; the Franklin Institute; the National Electric Light Association; the National Commercial Gas Association and the American Association for the Conservation of Vision. He was one of the lecturers in the Johns Hopkins University course in illuminating engineering given under the auspices of the Illuminating Engineering Society.

NORMAN MACBETH.

Obituary.

MR. ROBERT H. WATSON, secretary and treasurer of the Northwestern Electric Company of Chicago and a highly esteemed electrical business man of that city, died on April 26. Mr. Watson had been engaged in the supply business in Chicago for a number of years, and for some time was connected with the Gregory Electric Company. Before that he was associated with the old Knapp Electric Works, and after leaving the Gregory Company was for a time with the Chicago office of the Gould Storage Battery Company. Later he engaged in business for himself under the name of Watson Electric Company, and thereafter formed his connection with the Northwestern Electric Company. He was active in church work and made an enviable reputation for probity and straightforwardness in all his business dealings. He leaves a wife and two daughters and also a son who is, unfortunately, dangerously ill.

Trade Publications.

PROTECTIVE APPARATUS.—Folder 4110, issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., covers the line of static protective apparatus manufactured by this company.

INCANDESCENT LAMPS.—The New York & Ohio Company, Warren, Ohio, is issuing two illustrated folders, one giving a revised price schedule and the other a revised discount schedule for the incandescent lamps.

PROTECTIVE PAINT.—The Joseph Dixon Crucible Company, of Jersey City, N. J., has published a neat folder entitled, "Maintenance Painting for Electric Railways." It gives excellent photographs of street-railway viaducts, power-plant stacks and car trucks painted with silica-graphite paint. The folder explains in a very interesting way the special adaptability of this paint for street railway uses.

INDUCTION WATT-HOUR METERS.—The Sangamo Electric Company, Springfield, Ill., is distributing a 24-page bulletin describing the construction, principle of operation and application of its improved induction watt-hour meter. The bulletin is profusely illustrated. The illustrations showing a radically new type of magnetic circuit will be of particular interest to electrical engineers dealing with alternating-current measurements.

ELECTRIC VEHICLE INSTRUCTION BOOK.—During the past year the charging of electric-vehicle batteries has become a considerable factor in increasing the day load of central stations for the purpose. The Sangamo Electric Company, Springfield, Ill., has issued an attractive instruction book showing the charging connections of the more prominent vehicles, which will interest the managers contemplating the installation of charging apparatus.

ELECTRIC SPECIALTIES.—The Minerallac Electric Company, 400 South Hoyne Avenue, Chicago, has issued three new bulletins relating to its product. The first describes cable and conduit hangers and porcelain bushings. Another is devoted to an electroscope for indicating the presence of dangerous potentials. This instrument is made in two sizes, one intended for pocket use and the other for power house or substation operators. The third bulletin describes the Chicago printing attachment for watt-hour meters.

SWITCH AND OUTLET BOXES.—Catalog No. 25 of the Chicago Fuse Manufacturing Company, 1014 West Congress Street, Chicago, entitled "Stamped Steel Switch and Outlet Boxes," illustrates and describes and lists a complete line of outlet and switch boxes. The catalog is intended to cover all the requirements ordinarily met with in electrical installations where switch boxes or outlet boxes are required, either for old or new work. Several new forms of boxes and ceiling plates, as well as a new universal switch box, with a corresponding line of special covers, are described. A new and useful feature of this catalog is a table showing "Union" catalog numbers and the corresponding catalog numbers of other manufacturers, also shipping quantities per barrel.

BUSINESS NOTES.

MR. CHARLES G. ATKINS, consulting engineer, has moved his office from the Monadnock Building to the Ellsworth Building, Chicago.

THE WESTERN LUMBER & POLE COMPANY has moved from the Charles Building to the new Electric Building, Denver, Col.

THE TRIUMPH ELECTRIC COMPANY has changed its Chicago office address from 275 La Salle Street to 301 Fort Dodge Building.

PATTISON BROTHERS, consulting engineers, have moved their offices from the Fuller Building to the Centurian Building, New York.

C. O. MAILLOUX and C. E. KNOX, consulting engineers, have moved their offices from 76 William Street to 90 West Street, New York.

THE JOHN C. DOLPH COMPANY has moved its insulation factory from 135 West Avenue, Long Island City, to 317 New Jersey Railroad Avenue, Newark, N. J.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, of Plainville, Conn., has removed its New York office from 136 Liberty Street to 114 Liberty Street.

MR. E. H. NAGELSTOCK, formerly with the Gregory Electric Company, has opened an office at 1206 Rector Building, Chicago, for the sale of all kinds of electrical apparatus.

HODENPYL, WALBRIDGE & CO. have dissolved partnership, and the firms of H. D. Walbridge & Co. and Hodenpyl, Hardy & Co. have been formed, with offices at 7 Wall Street, New York.

MR. FAY WOODMANSEE, electrical engineer with Sargent & Lundy, engineers, Chicago, has resigned to engage in the practice of consulting engineering in Chicago with Messrs. C. J. Davidson and E. O. Sessions.

MR. E. O. SESSIONS, engineer in the Chicago office of the General Electric Company, has resigned to engage in the practice of consulting engineering in Chicago with Messrs. Fay Woodmansee and C. J. Davidson.

THE SPRAGUE ELECTRIC COMPANY has removed its Boston office from the Weld Building to 201 Devonshire Street, where more room has been obtained in order to handle expeditiously the company's products in the New England territory.

MR. C. J. DAVIDSON, chief engineer of power plants for the Milwaukee Electric Railway and Light Company, has resigned to engage in the practice of consulting engineering in Chicago with Messrs. Fay Woodmansee and E. O. Sessions.

THE MURRAY IRON WORKS COMPANY has just completed an extensive addition to its boiler shops at Burlington, Iowa, in the shape of a steel frame building 140 ft. by 120 ft., with a large traveling crane down the middle and smaller cranes on the sides.

THE INTERNATIONAL STEAM PUMP COMPANY, New York, has established a publicity department which will hereafter handle its advertising and news matter. This department is in charge of Mr. Henry R. Cobleigh, who has been mechanical editor of the *Iron Age* for the last seven years.

THE STAVE ELECTRICAL COMPANY has removed from 27 West 27th Street to 131 Hudson Street, New York. This move was made necessary by the increasing demand for the company's new long-life flaming arc lamps. Mr. Theodore Stave has recently returned from abroad, where he looked over the factory and arranged for prompt shipments to this country in order to take charge of the trade of the United States with the greatest dispatch.

MR. PERCIVAL R. MOSES, who has moved his office as consulting engineer from 45 West Thirty-fourth Street, to 366 Fifth Avenue, New York, has associated with him for the handling of industrial equipments Mr. John Fallon, formerly mechanical engineer of the Tennessee Copper Company and Stanley G. Flagg & Company; Mr. Arthur V. Farr, formerly with Szepesi & Farr; Mr. Alphonse Kaufman, formerly manager and chief engineer of the Alaska Chemical Company, and Mr. J. N. Walton, recently storage battery expert with the Edison Electric Illuminating Company of Brooklyn.

THE GENERAL ELECTRIC COMPANY OF TEXAS has removed its principal office, at Dallas, from the Prætorian Building to its new commodious brick warehouse building, where a floor area of 300,000 sq. ft. is available. The present three-story building is arranged for the addition of a fourth floor when necessary. Mr. V. E. Raggio is manager of the Dallas office, and Mr. A. N. Feineman is assistant manager. Mr. William Taussig, of Chicago, assistant to the president of the Texas company, Mr. J. W. Johnson, of Chicago, will be stationed at Dallas during the next six months The General Electric Company of Texas does business in the States of Texas and Oklahoma.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Geo. S. Emery, 11 N. Royal St., Mobile, Ala. Annual convention in November.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next semi-annual meeting at Toronto, Canada, September or October, 1911.

American Electro-Therapeutic Association. Secretary, Dr. J. Willard Travell, 27 East 11th St., New York. Next meeting at Philadelphia, Pa., Sept. 5, 6 and 7, 1911.

American Institute of Consulting Engineers. Secretary-Treasurer, Eugene W. Stern, 103 Park Ave., New York City. The Council meets the first Friday of every month.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September. Annual convention, Chicago, June 26-30, 1911.

American Electric Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia. Annual convention, Atlantic City, N. J., October 9-13, 1911.

American Electric Railway Engineering Association. Secretary, Norman Litchfield, Interborough Rapid Transit Company, New York. Annual convention, Atlantic City, N. J., Oct. 9-13, 1911.

American Electric Railway Association. Secretary, H. C. Donecker, Engineering Societies Building, 29 West 39th St., New York. Annual convention, Atlantic City, N. J., Oct. 9-13, 1911.

American Physical Society. Secretary, Ernst Merritt, Cornell University, Ithaca, N. Y.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark. Annual Convention, May 16, 17 and 18, 1911, at Little Rock, Ark.

Association of Iron and Steel Electrical Engineers. Secretary, James Farrington, Steubenville, Ohio.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, 135 Adams St., Chicago. Next meeting, Boston, Mass., June, 1911.

Association of Railway Electrical Engineers. Secretary, J. Andreucetti, Chicago & Northwestern Railway, Chicago. Next annual meeting (Hotel La Salle, Chicago), November 6 to 10, 1911. Semi-annual meeting, Washington, 1911.

Association of Edison Illuminating Companies. Secretary, N. T. Wilcox, Lowell, Mass.

Canadian Electrical Association. Secretary, T. S. Young, 220 King St., West, Toronto, Can.

Colorado Electric Light, Power & Railway Association. Secretary, F. D. Morris, 323 Hagerman Building, Colorado Springs, Col. Annual convention, Glenwood Springs, Col., September 13-15, 1911.

Electric Vehicle Association of America. Secretary, Harvey Robinson, 124 West 42d St., New York. Meetings, fourth Tuesday of each month.

Electric Club, Chicago. Secretary, N. F. Obright, 1500 American Trust Bldg., Chicago. Meets every Wednesday noon, 303 Wabash Ave., Chicago.

Electrical Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York. Annual meeting at Buffalo, N. Y., June 20, 1911.

Electric Trades Association of Philadelphia. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursday of each month.

Electrical Contractors' Association of State of Missouri. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo. Next meeting in Kansas City, Saturday, June 10, 1911.

Electrical Salesmen's Association. Secretary, Francis Raymond, 125 Michigan Ave., Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

Electrical Credit Association of Chicago. Secretary, Frederic P. Vose, Marquette Building, Chicago. Annual meeting Chicago, November 2, 1911.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Credit Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of directors meets second Thursday of each month.

Empire State Gas and Electric Association. Secretary, Charles H. B. Chapin, Engineering Societies Building, 29 West 39th St., New York.

Florida Electric Light & Power Association. Secretary, H. C. Adams, West Palm Beach, Fla. Next meeting, Jacksonville, Fla., April 4 and 5, 1911.

Illinois State Electrical Association. Secretary H. E. Chubbuck, Peoria, Ill.

Illuminating Engineering Society. Secretary, P. S. Millar, Engineering Societies Building, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago. Annual convention, Chicago, 1911.

Independent Electrical Contractors' Association of Greater New York. Secretary, L. H. Woods, 2355 Jerome Ave., New York.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, J. V. Zartman, Indianapolis, Ind. Annual meeting, August 23 and 24, 1911.

INTERNAL COMBUSTION ENGINE ASSOCIATION. Secretary, Chas. Kratch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex. Next meeting, St. Paul, Minn., 1911.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Dubuque, Ia.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Independence, Kan., Sept. 21 and 22, 1911.

MAINE ELECTRICAL ASSOCIATION. Secretary, Walter S. Hyman, Waterville, Maine.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, Herbert Silvester, 18 Washington Boulevard, Detroit, Mich. Annual convention on board the S.S. Minnesota, June 19-22, 1911.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, T. C. Gordon, Little Falls, Minn.

MISSISSIPPI ELECTRIC ASSOCIATION. Secretary, A. H. Jones, McComb City Light and Power Co., McComb City, Miss. Annual convention, Gulfport, Miss., June 20-21, 1911.

MISSOURI ELECTRIC, GAS, STREET RAILWAY & WATER ASSOCIATION. Secretary, N. J. Cunningham. Springfield Gas & Electric Co., Springfield, Mo.

NATIONAL ARM, PIT & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Third convention, Fort Pitt Hotel, Pittsburg, June 6-8, 1911.

NATIONAL ELECTRIC CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Niagara Falls, July 19, 1911.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive Secretary, T. C. Martin, Engineering Societies Building, 33 West 39th St., New York. Annual convention, New York City, May 29-June 3, 1911.

NATIONAL ELECTRIC LIGHT ASSOCIATION, NEW ENGLAND SECTION. Secretary, Miss O. A. Bursiel, 39 Boylston St., Boston, Mass.

NATIONAL ELECTRIC LIGHT ASSOCIATION, PENNSYLVANIA SECTION. Secretary-Treasurer, Van Dusen Rickert, Pottsville, Pa.

NATIONAL ELECTRIC LIGHT ASSOCIATION, NEBRASKA SECTION. Secretary-Treasurer, S. J. Bell, David City, Neb.

NATIONAL ELECTRIC LIGHT ASSOCIATION, GEORGIA SECTION. Secretary-Treasurer, H. M. Corse, Columbus Railroad Company, Columbus, Ga.

NATIONAL ELECTRIC LIGHT ASSOCIATION, BALTIMORE SECTION. Secretary, A. W. Hawkes, Jr., Continental Building, Baltimore, Md.

NATIONAL ELECTRICAL INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn. Next meeting, New York, March, 1911.

NATIONAL ELECTRICAL CREDIT ASSOCIATION Secretary, Frederic P. Vose, 343 Marquette Bldg., Chicago.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary R. Sweetland, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1913.

NATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Joseph B. Ware, Grand Rapids, Mich.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, Frank McMaster, Beatrice, Neb.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ORLEANS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, L. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, Engineering Societies Building, 33 West 39th St., New York.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, Ohio, July 25-28, 1911.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, Prof. I. E. Sanborn, Ohio State University, of Columbus, Ohio. Next meeting at Youngstown, Ohio, May 18 and 19, 1911.

ORDER OF REJUVENATED SONS OF JOVE. Mercury (Secretary), R. M. Van Vleet, 1157 Monadnock Bldg., Chicago, Ill. Annual meeting Denver, Col., Oct. 16-18, 1911.

PITTSBURGH ELECTRIC BOOSTER CLUB. Recording Wattmeter, O. R. Rombach, 919 Liberty Ave., Pittsburgh, Pa. Meetings, fourth Monday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y. Annual meeting at Pittsburgh, June 27, 28 and 29, 1911.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, E. B. Moore, 39 Trinity Place, Boston. Monthly meeting, first Saturday of each month, at the Massachusetts Institute of Technology, Boston.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION. Secretary, D. G. Fisher, 1316 Commerce St., Dallas, Tex.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, C. G. Reel, Kingston, N. Y. Annual meeting at Cooperstown, June 27 and 28, 1911.

VERMONT ELECTRICAL ASSOCIATION. Secretary-Treasurer, A. B. Marsden, Manchester, Vt.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 145 Monroe St., Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

WIRELESS INSTITUTE. Secretary, Alfred N. Goldsmith, College of the City of New York, New York.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, George Allison, Stephenson Building, Milwaukee, Wis. Next annual meeting, Milwaukee, January, 1912.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 25, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

990,219. SUPERVISORY SIGNALING SYSTEM; W. G. Blauvelt, New York, N. Y. App. filed Oct. 26, 1910. The central station has a plurality of supervisory signals, all positioned and adapted to signal one and the same central operator, there being automatic mechanism at central for successively bringing the signal devices under the control of the substation.

990,229. INDIVIDUAL PROTECTOR UNIT AND MEANS FOR MOUNTING SAME; F. B. Cook, Chicago, Ill. App. filed Aug. 2, 1909. Cable terminal with protector units which may be connected with the cable after it is installed. The protectors consist of sheet-metal plates carrying hooks and hollow binding posts and a notched base plate engaging the hooks, each unit having a pair of spring forks to clamp the corresponding pair of binding posts.

990,234. TERMINAL FOR ELECTRIC CABLES; C. W. Davis, Edgeworth, Pa. App. filed June 19, 1909. Terminal head for protecting the cable where it is connected with the air line by means of a thimble, a non-conducting sleeve and a resilient stopper between the cable and the sleeve.

990,235. JUNCTION BOX STRUCTURE FOR ELECTRICAL CONDUCTORS; C. W. Davis, Edgeworth, Pa. App. filed July 1, 1909. A casing with an offset in the lower wall which supports a partition, pole pieces through the partition and busbars in the offset portion of the wall in line with the partition, the terminals being in oil.

990,236. DAMPER REGULATOR; R. J. Davis, Chicago, Ill. App. filed Aug. 29, 1908. Automatic regulator for furnaces operated by weights controlled by electromagnets whose circuits are controlled by thermostats.

990,237. DAMPER REGULATOR; R. J. Davis, Chicago, Ill. App. filed Jan. 3, 1910. Improvement on 990,236 for varying the adjustment of the damper.

990,265. ELECTRICALLY HEATED TOOL; H. Hertzberg, New York, A. A. Low, Horesnoe, and M. J. Wohl, New York, N. Y. App. filed Nov. 4, 1907. Soldering iron with hollow handle containing the circuits and heating units. The chambered mass of solid metal contains the heating units.

990,274. STORAGE BATTERY; E. J. Knapp and E. D. McLaughlin, Milwaukee, Wis. App. filed March 28, 1910. An electrode in the form of an overlapping shell which may be corrugated or perforated with an overlapping porous container inside the shell and active material within the container.

990,275. TELEPHONE TRANSMITTER; S. A. Koltonski, Boston, Mass. App. filed May 23, 1907. An antiseptic auxiliary diaphragm of celluloid is arranged in front of the sound diaphragm.

990,285. ELECTRIC SWITCH DEVICE; R. D. Moyer, Tampa, Fla. App. filed April 4, 1910. A plurality of rotatable disks with an oscillatory circuit-closing device actuated thereby, an electrical device for rotating the disks, step by step, the circuit of the latter being intermittently closed by a third disk.

990,342. ELECTRIC CLOCK AND LIKE INSTRUMENT; H. Creese, London, Eng. App. filed Dec. 10, 1909. A rotary body or disk carrying weighted arms which are projected successively at one side of the disk while the other weighted arms approach the center, thus giving driving effect; the arms are projected by electromagnets.

990,343. ELEVATOR SAFETY DEVICE; F. J. Crouch and H. E. Lloyd, Seattle, Wash. App. filed Sept. 9, 1910. Door lock for elevators with a bell crank, a bracket, a lever engaging the bell crank, a spring and a latch movable with the door to engage the lever, the parts controlling the circuit of the elevator motor.

990,234.—Terminal for Electric Cables.

990,353. JUNCTION OR TERMINAL BOX; L. Gudeman, New York, N. Y. App. filed June 8, 1910. A sleeve with plug openings, metallic conducting blocks lengthwise in the sleeve with passages in the line of the openings.

990,365. TELEPHONE REPEATER CIRCUIT; C. A. Kruckow, Halle-on-the-Saale, Germany. App. filed June 10, 1907. A symmetrical inductance consisting of two inductance coils with a circuit in series with a winding of each of the coils, a battery and a variable resistance controlled by the inductive helix of one half, a second circuit containing in series a winding of each of the inductance coils and an inductive helix controlling the variable resistance of the other half.

990,398. ELECTRIC CABLE; A. E. Sink, New York, N. Y. App. filed July 9, 1909. A plurality of insulated strands entwined longitudinally, one being grounded while another serves for transmission with an adjustable resistance in the grounded strand, the latter acting inductively to neutralize the induction within the transmitting strands .

990,461. BRUSH HOLDER FOR DYNAMO-ELECTRIC MACHINES; J. M. Smith and H. A. Knoener, East Orange, N. J. App. filed Aug. 22, 1908. A guide for the brush block with a weight engaging it, resisting the throwing off of the brush and a spring engaging the block independently of the weight.

990,464. CONTROLLER FOR ELECTRIC MOTORS; F. T. Taylor, New York, N. Y. App. filed July 10, 1909. For operating an electric motor in stages and automatically varying the range of operation by means of a plurality of concentric contact rings over which passes a radial arm carrying spring pressed contact plugs, which arm is driven by gears, geared to the motor.

990,468. TELEPHONE SYSTEM; F. G. Agrell, Stockholm, Sweden. App. filed Feb. 15, 1908. Call distributing system for a multi-party line, a switching circuit automatic means for connecting one end to the line and manual means for connecting the other end of the switching circuit with another circuit, and a supervising indicator to indicate a reverted call.

990,471. CIRCUIT-BREAKER; J. D. Bradford and B. R. Moore, Sacramento, Cal. App. filed March 21, 1910. A hollow body having a tapered end, the end wall having a slot through which the wire extends with a plug fitted within having an opening registering with the slot through which passes a second wire.

990,478. COUPLING FOR CONDUCTOR WIRES; A. D. Duvall and W. E. Dawson, Atlanta, O. App. filed Nov. 4, 1910. Portable coupling for the lineman, including a plate with a hook to receive one wire in which it is fastened by a set screw, a splice wire being passed through the other end of the plate.

990,483. CIRCUIT MAKING AND BREAKING MECHANISM; B. P. Hayes, Topeka, Kans. App. filed July 28, 1909. Stationary key, for telegraph transmitters, a movable key arm, character devices and a rocking beam with an arm for actuating the key arm and for engaging the character devices.

990,484. CASE FOR TELEGRAPH TRANSMITTERS; B. P. Hayes, Topeka, Kans. App. filed March 5, 1910. A keyboard transmitter case comprising a body, a seat pivoted within the body, which seat can be anchored against pivotal movement.

990,485. TELEGRAPH TRANSMITTER; B. P. Hayes, Topeka, Kans. App. filed May 17, 1910. Keyboard transmitter for telegraph with a circular closer, a motor, individually operated, character members, each actuating the telegraph key, and a keyboard for releasing the character members to control the motor.

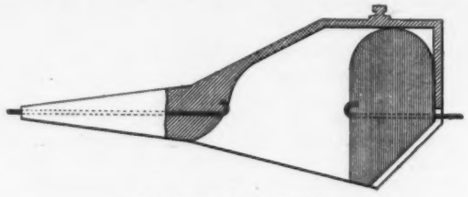
990,486. RAILWAY BLOCK SIGNAL SYSTEM; L. Johnson, Ames, Ia. App. filed Sept. 15, 1909. Lets a plurality of cars within a block and indicates by electric lamps .. warning to the approaching train.

990,489. PROCESS OF ELECTRICAL WELDING; N. Macneale, Cincinnati, O. App. filed Nov. 21, 1910. An electric welding machine with holding jaws, a bridge removably inserted between the jaws to establish electric contact in a way so as to preheat one of the pieces to be welded which is of lesser resistance than the piece to which it is to be welded.

990,492. BRUSH HOLDER; R. E. Noble and L. E. Mitchell, Chicago, Ill. App. filed July 11, 1910. A brush holder with a bracket to which a casing is adjustably secured, a trip pressing against the brush, and a strip pressing against the casing, with a spring pressing the strips apart.

990,493. ELEVATOR; C. O. Pearson, New York, N. Y. App. filed March 12, 1909. Friction drive traction elevator with a gas engine for supplying the motive power. The engine drives an electric generator, and there is a fluid pressure power transmission mechanism between the engine and the sheave, including a pump which is driven by the engine, a motor driven by fluid under pressure from the pump and electro magnets for varying the output of the pump to vary the speed of the motor.

990,508. PLUG RETAINER; J. J. Taylor and L. K. Hoss, Cherryvale, Kans. App. filed Jan. 24, 1911. Telephone cord plug retainer, the socket having an enlarged lower end with a metal plate on the bottom and a sleeve on the cord engaging the plate and movable laterally out of engagement to permit the plug to drop through the socket.



990,471.—Circuit Breaker.

990,512. ELECTRIC SWITCH; T. E. Barnum, Milwaukee, Wis. App. filed April 23, 1909. Operated from a distance by a circuit which includes an electrical magnet, the switch member being biased toward one position, and an operating solenoid having a movable plunger and a pivoted member carried thereby, which engages the switch member on opposite sides of the axis upon intermittent energization of the solenoid.

990,527. TELEPHONE MUFFLER; F. W. Cook, Denver, Colo. App. filed March 12, 1910. For confining the sound to prevent another from overhearing by means of a collapsible casing or muffler to fit over the transmitter and having a ring to cover the mouth.

990,602. HEAT-REGULATING SYSTEM; W. D. Smith, Chicago, Ill. App. filed Jan. 29, 1908. Heat regulator with a valve, an electric switch with a mechanical connection between the valve and the switch, the valve being moved by electromagnets with a thermostat to control the circuits, the device being applied to a steam radiator.

990,617. ELECTRIC COOKER AND TOASTER; R. Wiles, Chicago, Ill. App. filed Jan. 21, 1911. A cooker and toaster consisting of two pivoted bases, each containing a heating coil which may be arranged flat or turned up face to face.

990,620. RAIL BOND; J. M. Atkinson and L. A. Scovil, Chicago, Ill. App. filed Aug. 15, 1902. Two terminal ends are welded to opposite sides of the body or strands of wires and are there welded, the head being surrounded by a metallic casing, the body, head and casing being compressed together and welded to form a homogeneous structure.

990,634. ELECTRICAL RAIL BOND; H. B. Conway, Boone, W. Va. App. filed Nov. 7, 1910. A bolt with a tapered head and tapered bushing is inserted in an opening in the rail sections, and a nut draws the parts together.

990,638. TELEPHONE METER SYSTEM; G. Deakin, Oakland, Cal. App. filed Sept. 10, 1908. The meter is associated with the subscriber's line and records a unit when first answering. The lines for terminating calls are divided into a class which controls the calling line meter and another without a meter.

990,647. ALTERNATING CURRENT MOTOR; W. E. Goldsborough, Lafayette, Ind. App. filed May 1, 1903. A field ring with armature, armature coils and impedances in leads from the coils, an iron core with short-circuited winding which can be brought into adjustable inductive relation with the impedance. For induction motors.

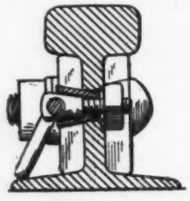
990,661. METHOD OF REGENERATING STORAGE BATTERIES; C. Luckow, Cologne, Germany. App. filed Oct. 26, 1909. Replaces the electrolyte by water, reverses the current through the battery, then turns the acidified water into a saline solution by adding salt, reverses the current again and replaces the concentrated solution by the working electrolyte.

990,685. TELEPHONE SIGNALING SYSTEM; E. M. Tormin, Newton Center, Mass. App. filed March 29, 1910. For notifying a subscriber that his line is busy, etc., by means of an electrically operated vibrator with a pair of contacts which are automatically opened and closed.

990,709. INCANDESCENT ELECTRIC LAMP; H. T. Crane, Cincinnati, Ohio. App. filed June 12, 1905. The reflection member of a lamp is formed on the fitting section which is screw-threaded and surrounds the base of the lamp to form a reflecting envelope.

990,765. ELECTRIC FURNACE; J. H. Nau, New York, N. Y. App. filed Oct. 30, 1910. For refining molten pig iron by means of an oscillating hearth into which the electrodes project.

990,767. ELECTRIC SWITCH OR CONTROLLER; R. E Noble and L. E. Mitchell, Chicago, Ill. App. filed Aug. 12, 1908. For electric cars or locomotives, including a switch and blow-out magnet, the contact member comprising a fork, carrying wheels which are held separated by a spring.



990,634.—Electrical Rail Bond.

990,771. SIGNALING DEVICE; F. J. Poinan, Rochester, N. Y. App. filed March 6, 1909. Automobile signal to be applied to the lamp and to inform the operator when the lamp burns low by means of a thermostat within a zinc cylinder which is mounted above the lamp burner in the chimney.

990,790. CIRCUIT INTERRUPTER; E. M. Tormin, Newton Center, Mass. App. filed Oct. 7, 1910. For notifying that the line called is busy by means of an electric vibrator consisting of an electromagnet vibrating an oscilating armature which controls the contacts.